PETTER

DIESEL ENGINES

AA1-AB1

OPERATORS HANDBOOK

ISSUE 2

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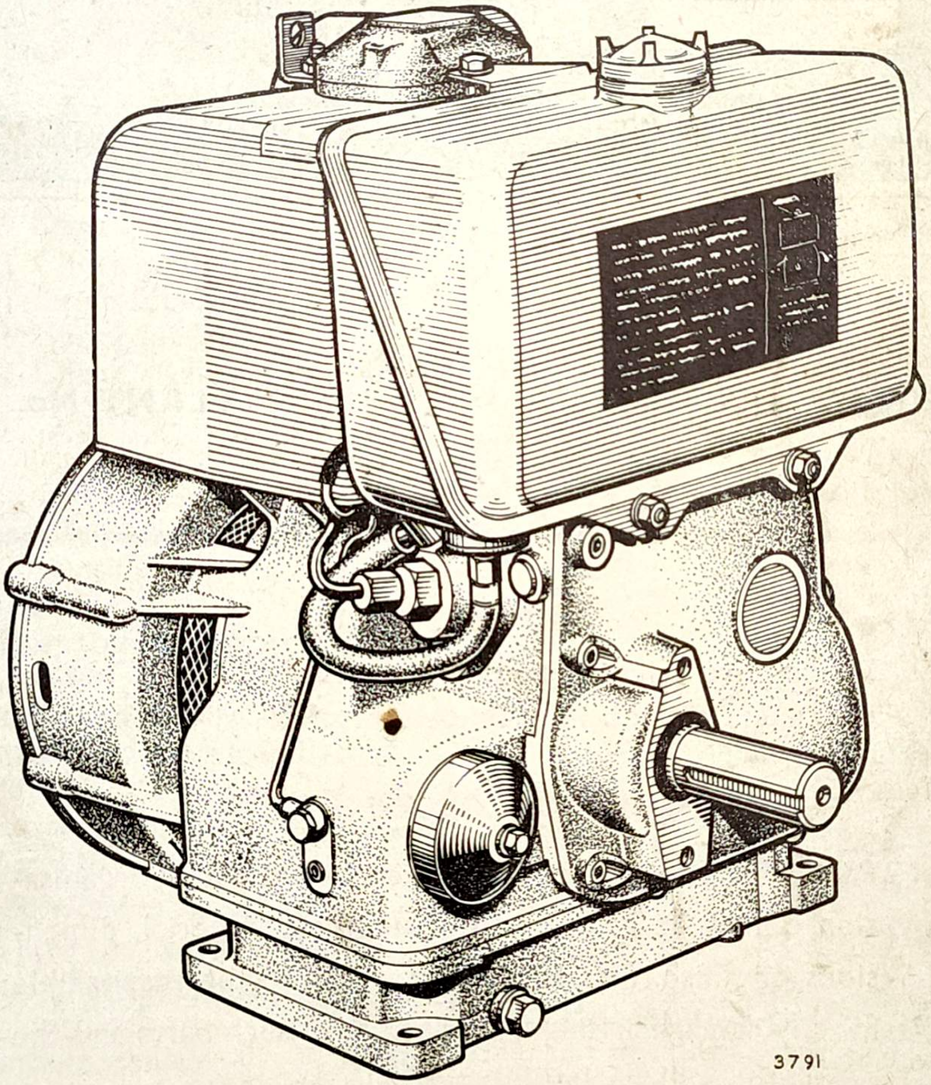
Petter Diesel Engines

TYPES AA1 and AB1



This book will help the user to get the best results from the engine. No engine will run without care, but it will give good service if given the attention described in this book.

a technical data

AA1

Bore (nominal)	2·75in (69·85mm)
Stroke	2·25in (57·15mm)
Power and Speed (B.S. continuous rating):	
	1·5 bhp at 1500 rev/min
	1·8 bhp at 1800 rev/min
	2·1 bhp at 2100 rev/min
	2·5 bhp at 2500 rev/min
	3·0 bhp at 3000 rev/min
	3·5 bhp at 3600 rev/min
Cubic capacity	13·4 in^3(219 cm^3)
Compression ratio	17:1
Lubricating oil pressure (min.)	35 lbf/in^2 (2·46 kgf/cm^2)
Fuel injection release pressure	2350/2650 lbf/in^2 (165·2/186·3 kgf/cm^2)
Fuel injection timing (by spill):	
Fixed speed	
Up to 2200 rev/min	24° before TDC
2200 to 3300 rev/min	27° before TDC
3300 to 3600 rev/min	33° before TDC
Variable speed	33° before TDC
Inlet valve opens	16° before TDC
Inlet valve closes	36° after BDC
Exhaust valve opens	44° before BDC
Exhaust valve closes	8° after TDC
Reduction gear ratio	4:1 6:1
Fuel tank capacity (engine mounted)	6½ pints (3·8 litres)
Oil capacity	3¼ pints (1·9 litres)
Lubricating oil	See approved list
Fuel	A high grade light distillate diesel fuel in accordance with B.S. Specification No. 2869:1967 Class A1 or A2
Starter motor battery	12 Volts 50 Ampere hour (min.) Negative earth

NOTE: Oil capacities, etc., are based on the Imperial (U.K.) gallon

technical data

Bore (nominal)	3in (76·2mm)
Stroke	2·25in (57·15mm)
Power and Speed (B.S. continuous rating):	2·3 bhp at 1500 rev/min 2·7 bhp at 1800 rev/min 3·2 bhp at 2100 rev/min 3·8 bhp at 2500 rev/min 4·5 bhp at 3000 rev/min 5·0 bhp at 3600 rev/min
Cubic capacity	15·9 in^3 (261 cm^3)
Compression ratio	16·25:1
Lubricating oil pressure (min.)	35 lbf/in^2 (2·46 kgf/cm^2)
Fuel injection release pressure	2350/2650 lbf/in^2 (165·2/186·3 kgf/cm^2)
Fuel injection timing (by spill):	
Fixed speed	
Up to 2200 rev/min	23° before TDC
2200 to 2700 rev/min	26° before TDC
2700 to 3300 rev/min	30° before TDC
3300 to 3600 rev/min	35° before TDC
Variable speed	30° before TDC
Inlet valve opens	13° before TDC
Inlet valve closes	38° after BDC
Exhaust valve opens	38° before BDC
Exhaust valve closes	13° after TDC
Reduction gear ratio	4:1 6:1
Fuel tank capacity (engine mounted)	9 pints (5·13 litres)
Oil capacity	3¼ pints (1·9 litres)
Lubricating oil	See approved list
Fuel	A high grade light distillate diesel fuel in accordance with B.S. Specification No. 2869:1967 Class A1 or A2
Starter motor battery	12 Volts 50 Ampere hour (min.) Negative earth

NOTE: Oil capacies, etc., are based on the Imperial (U.K.) gallon

Camshaft end float	0·003/0·010in (0·08/0·25mm)
Crankshaft end float (new)	0·005/0·017in (0·13/0·43mm)
Crankshaft end float (not to exceed)	0·020in (0·51mm)
Crankpin ovality (not to exceed)	0·0025in (0·063mm)
Cylinder bore wear (not to exceed)	0·010in (0·25mm)
Piston ring gap (new)	0·011/0·016in (0·28/0·41mm)
Piston ring gap (not to exceed)	0·045in (1·14mm)
Exhaust valve lift by decompressor (max.)	0·015in (0·38mm)
Bumping clearance	0·022/0·026in (0·56/0·66mm)
Valve rocker clearances (cold)	0·004in (0·10mm)
Valve depth from cylinder head face (new) AA1	0·025/0·042in (0·64/1·07mm)
AB1	0·039/0·057in (0·99/1·45mm)
Main bearing clearance (new)	0·0008/0·0029in (0·020/0·077mm)
Large end bearing clearance (new)	0·0010/0·0035in (0·025/0·09mm)
Small end bush diameter (fitted)	0·8753/0·8757in (22·233/22·243mm)
Reduction gear power take-off shaft end float	0·002/0·005in (0·05/0·13mm)
Cylinder reboring diameters (AA1):	
Standard	2·7500/2·7510in (69·850/69·875mm)
Oversize:	
0·020in	2·7700/2·7710in (70·358/70·388mm)
0·030in	2·7800/2·7810in (70·612/70·637mm)
0·040in	2·7900/2·7910in (70·866/70·891mm)
Cylinder reboring diameters (AB1):	
Standard	3·000/3·001in (76·20/76·23mm)
Oversize:	
0·020in	3·020/3·021in (76·71/76·73mm)
0·030in	3·030/3·031in (76·96/76·99mm)
0·040in	3·040/3·041in (77·22/77·24mm)
Crankshaft regrinding diameters:	Main journal and crankpin
Standard	1·6250/1·6245in (41·275/41·262mm)
Undersize:	
0·010in	1·6150/1·6145in (41·021/41·008mm)
0·020in	1·6050/1·6045in (40·767/40·754mm)
Lubricating oil pump:	
Rotor end clearance (new)	0·001/0·0025in (0·025/0·064mm)
Rotor end clearance (not to exceed)	0·005in (0·127mm)
Rotor form clearance (new)	0·002/0·005in (0·051/0·127mm)
Rotor form clearance (not to exceed)	0·008in (0·203mm)
Shaft/bore clearance (new)	0·0015/0·003in (0·038/0·076mm)
Shaft/bore clearance (not to exceed)	0·005in (0·127mm)
Rotor shaft diameter (new)	0·5918/0·5923in (15·032/15·044mm)

TORQUE SPANNER SETTINGS

	lbf ft	kgf m
Large end bolt	25	3·46
Cylinder head nut	20	2·77
Injector stud nut	10	1·38
Flywheel nut	155	21·43
Flywheel extension or gearwheel bolt	27	3·73
Lubricating oil pump screw	10	1·38
Lubricating oil filter centre bolt	10	1·38
Fuel pump delivery union body	15	2·07
Crankshaft and camshaft extension shaft screw	14	1·94
Crankshaft gearwheel retaining screw	27	3·73
Camshaft gearwheel retaining screw	27	3·73
Starting handle shaft retaining screw (Raised Hand Starting)	27	3·73
Mounting plate screw (4:1 Hand Starting)	18	2·49
Sliding plate locating screw (4:1 Hand Starting)	18	2·49
Sliding plate stop screw (4:1 Hand Starting) (Flywheel end)	8	1·10
Gearwheel retaining clip screw (4:1 Hand Starting) (Flywheel end)	12	1·66
Gearwheel retaining screw (4:1 Hand Starting) (Gear end)	18	2·49

APPROVED LUBRICANTS

Supplier	**U.K. Winter & Summer** *Up to 30°C (86°F)*	**Tropical** *Above 30°C (86°F)*
Shell Group of Companies	Rotella SX Oil 10W Rotella TX Oil 10W Rotella TX Oil 10W/30 X-100 10W Talona Oil 10W	Rotella SX Oil 20/20W Rotella TX Oil 20/20W Rotella SX Oil 20W/40 Rotella TX Oil 20W/40 Super Oil Tractor Oil Universal
Mobil Oil Co. Ltd.	Delvac Special 10/30 Delvac 1210	Delvac Special 10W/30 Mobiloil Special 10W/30 Mobiland Universal 10W/30 Mobiloil 20W/30 Delvac 1220 Mobilgard 212
B.P. Companies	Vanellus 10W Super Visco-Static 10W/40	Vanellus 20W Vanellus 20W/30 Super Visco-Static 20W/50 Energol IC-M20W Tractor Oil Universal 20W/30
Castrol Ltd.	Deusol CRI 10 Deusol CRB 10 Deusol CRB 10W/30 Castrol CRI 10 Castrol CRB 10 Agricastrol Multi-Use 10W/30	Deusol CRI 20 Deusol CRB 20 Deusol CRB 10W/30 Deusol CRM Castrol CRB 20 Castrol 210 MX Agricastrol Multi-Use 20W/30

APPROVED LUBRICANTS—contd.

Supplier	U.K. Winter & Summer *Up to 30°C (86°F)*	Tropical *Above 30°C (86°F)*
Esso Petroleum Co. Ltd.	Essolube HD 10W Essolube HDX 10W Essolube D-3 HP 10W Essolube D-3 10W Essolube HDX 10W/30 Esso Motor Oil 10W	Essolube HD 20W Essolube HDX 20W Essolube D-3 HP 10W Essolube D-3 10W Essolube HDX 10W/30 Esso Motor Oil 20W
Caltex (U.K.) Ltd.	Supreme Five Star Motor Oil 10W/30 Custom Five Star Motor Oil 10W/30 Five Star Motor Oil 10W RPM Delo 200 Oil 10W/30 RPM Delo 200 Oil 10W RPM Delo 100 Oil 10W	Supreme Five Star Motor Oil 10W/30 Custom Five Star Motor Oil 10W/30 Five Star Motor Oil 20/20W RPM Delo 200 Oil 10W/30 RPM Delo 200 Oil 20/20W RPM Delo 100 Oil 20/20W
Chevron Oil Co. Ltd.	Chevron Delo Special Motor Oil 10W Chevron Delo 200 Motor Oil 10W	Chevron Delo Special Motor Oil 20/20W Chevron Delo 200 Motor Oil 2-/20W
Texaco Ltd.	Ursa Extra Duty 10W Ursa Extra Duty 10W/30 Havoline Motor Oil 10W Havoline Motor Oil 10W/40	Ursa Extra Duty 20W Ursa Extra Duty 10W/30 Havoline Motor Oil 20/20W Havoline Motor Oil 10W/40
Gulf Oil (G.B.) Ltd.	Gulflube Motor Oil XHD 10W Gulflube Motor Oil XHD 10W/30 Gulf Multi-G 10W/30	Gulflube Motor Oil XHD 20/20W Gulflube Motor Oil XHD 10W/30 Gulf Multi-G 10W/30 Gulf Superfleet 20W/30

NOTE: Since some SAE 10W oils are thinner than SAE 10W/30 multigrades at low temperatures, the starting of the engine at these temperatures will be marginally better using SAE 10W oils.

TROUBLE LOCATING CHART

Trouble	Reason	Causes	Suggested Remedy
Engine will not start	Temperature below 13°C (55°F)	Failure to prime (see Cold Starting)	Prime with lubricating oil
	Fuel supply failure Check by turning engine and listen for the characteristic squeak in the injector	No fuel in tank or air in fuel pipes	Fill tank and bleed fuel system, if applicable
		Broken fuel pipe or leaking connection	Repair or renew the pipe or tighten the connection
		Fuel filter choked	Fit new fuel filter element
		Faulty injector nozzle	Fit new nozzle
		Fuel pump plunger sticking	Fit new pump
		Fuel pump tappet sticking	Free and clean tappet
	Poor compression	Valves sticking	Free the valves
		Cylinder head loose	Tighten all nuts
		Cylinder head gasket blown	Fit new gasket
		Piston rings stuck in groove	Check rings and clean the piston
		Worn cylinder and piston	Overhaul the engine
		Valves not seating properly	Check valve springs Grind in if necessary Check the valve clearance
	Incorrect lubricating oil	Too high a viscosity oil causing excessive engine drag	Drain the sump and fill with correct oil

TROUBLE LOCATING CHART—contd.

Trouble	Reason	Causes	Suggested Remedy
Engines starts but fires intermittently or soon stops	Faulty fuel supply	Water in the fuel Faulty injector nozzle Fuel filter choked Air in fuel pipes	Drain fuel system and fill with clean fuel Fit new nozzle Fit new filter element Bleed the system, if applicable
	Faulty compression	Broken valve spring Sticking valve Pitted valve	Fit new spring Free the valve Grind or renew
	Dirty exhaust	Blocked exhaust pipe or similar	Clean out
Engine lacks power and/or shows dirty exhaust	Faulty fuel supply	Faulty fuel pump Faulty injector nozzle Unsuitable fuel	Fit new pump Fit new nozzle Drain the fuel system and fill with correct fuel
	Out of adjustment	Valve clearance incorrect Fuel timing incorrect	Adjust Adjust
	Dirty engine	Blocked exhaust pipe or similar Dirty air cleaner Faulty piston ring Excessive carbon on piston and cylinder head Worn cylinder and piston	Clean out Clean out Fit new ring Decarbonise Overhaul the engine

TROUBLE LOCATING CHART—contd.

Trouble	Reason	Causes	Suggested Remedy
Faulty running	Knocking	Carbon on piston crown	Decarbonise
		Injector needle sticking	Fit new nozzle
		Fuel timing too far advanced	Adjust timing
		Broken piston ring	Fit new ring
		Slack piston	Fit new piston rings
		Worn large end bearing	Renew and check lubrication
		Loose flywheel	Refit
		Worn main bearing	Renew and check lubrication
	Overheating	Cooling system failure	Check that the cooling system is in order and free from obstruction
		Overloaded	Reduce the load
		Excessive valve clearance	Adjust
		Lubricating oil failure	Check the engine and lubricating oil system for damage. If in order, top up sump and check running
	Speed surges	Overheating	See above
		Governor sticking	Check the governor for correct operation
		Air in fuel pipes	Bleed the system, if applicable
	Sudden stop	Empty fuel tank	Fill tank and bleed system, if applicable
		Choked injector	Fit new nozzle
		Fuel pipe broken	Repair or renew
		Seized piston	Fit new cylinder and piston
	Heavy vibration	Faulty installation	Check holding down bolts and flexible mountings and couplings if fitted

b installation

1. Engine bearers

Engine mounting bearers or framework must be of rigid construction and neither deflect nor twist when subjected to the weight of the engine and any ancillary equipment.

2. Erection

(*a*) Installation drawings are obtainable from *Petters Ltd or their agents.*

(*b*) Provision must be made for:
  - (i) Oil filler cap removal and oil draining.
  - (ii) Fuel and oil filter and air cleaner maintenance.
  - (iii) Starting and operation of controls.

(*c*) Only good quality holding down bolts or studs may be used. Setscrews must NOT be used.

(*d*) *Petters or their agents* should be consulted in the following cases:
  - (i) Before proceeding with any new form of installation.
  - (ii) Where the use of anti-vibration mountings is contemplated. (An unsuitable choice can be dangerous.)
  - (iii) When a portable installation is contemplated. In this instance a *Petter* engineer should be present when the initial installation is made.

(*e*) On direct driven sets the driving and driven units must be lined up and a flexible coupling fitted.

3. Exhaust

(*a*) An exhaust manifold flange is available from *Petters Ltd or their agents* and is tapped 1in BSP to enable a threaded exhaust pipe to be fitted.

(*b*) A 1in BSP exhaust pipe is suitable for lengths up to 18in (457mm). For lengths from 18in (457mm) to 10ft (3m), and from 10ft (3m) to 20ft (6m), the manifold must be adapted and exhaust pipes of 1½in BSP and 2in BSP respectively used. For exhaust pipe sizes for lengths in excess of 20ft (6m), consult *Petters Ltd or their agents.*

(*c*) An acoustic type silencer for fitting to an exhaust pipe is obtainable from *Petters Ltd or their agents.* It is important that the thread size of this type of silencer is the same as that of the exhaust pipe, and that a tail-pipe is fitted. The length of the tail-pipe must be ten times the inside diameter of the exhaust pipe, i.e. a tail-pipe 15in (381mm) long must be fitted to a 1½in BSP acoustic silencer.

(*d*) The exhaust system should be as short as possible and with a minimum of bends, otherwise a serious reduction of power will result.

(*e*) A short length of flexible exhaust pipe should be included between the engine and main run of piping.

4. Air intake

Air is taken in through an air cleaner.
Engines installed in confined space requires good ventilation to ensure a plentiful supply of cool, clean air.

5. Cooling (Fig. 1)

(*a*) Cooling air is supplied by the flywheel fan and care must be taken to ensure that the fan cowling air intake is unobstructed.

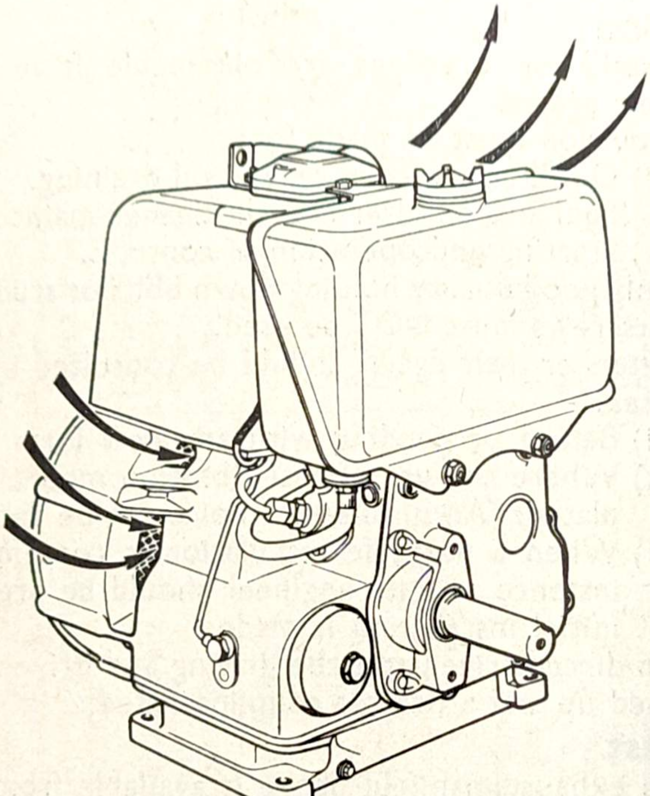


Fig. 1

(*b*) Engines mounted inside housings or confined spaces must be provided with ample openings for the free circulation of air.

(*c*) UNDER NO CIRCUMSTANCES MAY ENGINES BE RUN WITHOUT FAN COWLINGS IN POSITION.

6. Lubrication

(*a*) The engine oils listed under Approved Lubricants are heavy duty oils with a minimum performance level as specified by:
British Defence Specification No. 2101D
or
U.S. Specification MIL/L/2104B

(*b*) Suitable additional heavy duty engine oils will be recommended by a local oil distributor but a minimum performance level as above must be specified.

(*c*) *Petters Ltd or their agents* should be consulted if doubt arises regarding the selection of an engine oil.

(*d*) MARINE AUXILIARY INSTALLATIONS. Although two viscosities of oil are recommended for different climatic conditions, it is not always practical to change oils as the engine passes from one climate to another. Under these circumstances, for engines operating fire pumps or other equipment required IN AN EMERGENCY, it is recommended that the oil selected should be of a viscosity suitable for the coldest climate likely to be encountered. It should be noted that this recommendation is made with ease of hand starting as a first consideration.

7. Fuel

(*a*) The bulk storage of diesel fuel is subject to official regulations, but generally, storage is permitted above ground provided containers of authorised construction and capacity are used. DO NOT use galvanised containers or the zinc coating will react with the fuel and damage the fuel injection equipment.

(*b*) To prevent the harmful effects of moisture absorbed by fuel, provision must be made for draining off water which may accumulate at the base of the storage tank. The amount of water absorbed by fuel can be minimised by keeping storage tanks as full as possible and ensuring that filler caps, inspection covers, etc., have effective sealings.

(*c*) Tank cocks for withdrawing fuel should be fitted a short distance above the base, enabling clean fuel to be withdrawn without disturbing water or sediment.

(*d*) To ensure proper working of the fuel system the fuel must always be CLEAN.

(*e*) Fuel should be allowed to settle before use. Sludge or water at the bottom of the container must not be used. Due to increased engine repair costs, a cheap fuel may prove very expensive in the long run.

(*f*) Funnels or cans used for fuel should not be used for anything else and must be kept absolutely clean. They should be thoroughly dried before use.

(*g*) The fuel tank should always be filled through a strainer. Occasionally the tank should be flushed out with petrol or paraffin.

(*h*) The fuel used should be high grade light diesel fuel, gas oil, or DERV fuel. It should comply with B.S.2869:1967 Class A1 or A2, an extract of which is as follows:

	Class A1	Class A2
Cetane number (min.)	50	45
Viscosity (kinematic) at 37·8°C (100°F)	1·6 to 6·0 s	1·6 to 6·0 s
Carbon residue. Conradson on 10% residue (by weight) (max)	0·2%	0·2%

Distillation recovered at 357°C (675°F) (by volume)	90%	90%
Flash point (closed)	55°C (130°F)	55°C (130°F)
Water (by volume) (max)	0·05%	0·05%
Sediment (by weight) (max)	0·01%	0·01%
Ash (by weight) (max)	0·01%	0·01%
Sulphur (by weight) (max)	0·5%	1·0%

Class A1 fuel is intended primarily for automotive use. Class A2 is a general purpose fuel.

(*j*) Winter and summer grades of diesel fuels are marketed during the appropriate seasons and are also graded for that part of the world in which they are intended to be used. Diesel fuels available for use in low temperature climates are classified as 'Cold Start Reference Fuels'. Make sure that the fuel being used is suitable for the prevailing temperature conditions.

(*k*) Fuels for marine auxiliary engines required to operate under constantly differing climatic conditions should be suitable for the coldest conditions likely to be encountered. This is particularly important when considering fire pumps, etc. required to operate in an emergency.

(*l*) Some diesel fuels not suitable for low temperature may form wax under these conditions. If it is suspected that wax has formed, the whole engine should be gently warmed throughout and the fuel tank, pipes, injector and fuel injection pump then completely drained and flushed with the correct fuel. Refill the fuel system with the correct fuel and bleed and prime before attempting to start.

8. Governing

The governor controls the engine at a constant speed irrespective of load variations and will be either a fixed speed type governing the engine at its rated speed only or a variable speed type allowing the governed speed to be varied between idling and full rated speed.

The centrifugal forces on the governor balls are transmitted to the fuel pump rack. These forces, which vary with the speed of the engine, are balanced by an adjustable speeder spring. On a variable speed governor the tension of the speeder spring may be externally altered to give the required governed speed. On fixed speed governors the speeder spring may be adjusted to give an included variation of 10%.

For starting purposes only, operation of the overload stop lever fitted to variable speed governors allows the fuel pump rack to move into the excess fuel pump position. When the engine runs up to its rated speed the governor closes the rack which is then prevented from returning to the excess fuel position by the ratchet action of the overload stop cam.

The overload stop limiting the travel of the rack into the excess fuel position on variable speed engines is set by Petters

Ltd and the internal adjustments should not be disturbed. Interference with the setting may result in the engine being overloaded or not delivering its rated power. Excessive load must be avoided and this will be indicated by the engine running below its RATED speed and/or a dirty exhaust.

C drive arrangements

9. Engine marks

Power can be taken from more than one shaft at the same time provided the total power absorbed is not greater than the rated power of the engine.

Drive and starting arrangements are as follows:

MARK I	Drive at half engine speed on camshaft extension at end remote from flywheel. Rope starting at flywheel end.
MARK II	Drive at engine speed on crankshaft extension at end remote from flywheel. Rope starting at flywheel end.
MARK VI	Drive at engine speed from flywheel end. Rope starting at end remote from flywheel.

10. Pulley drive (Fig. 2)

When belt drives are used the belt should be as close to the engine as possible.

To prevent damage to new vee belts when fitting, the distance between the centre of the engine pulley (A) and the driven pulley (B) must be capable of a reduction from the designed running position.

Provision must also be made for an increase of at least 2½% over the designed running position to provide adjustment for belt stretch and wear during the life of the belts. Multiple belts should always be renewed in matched sets.

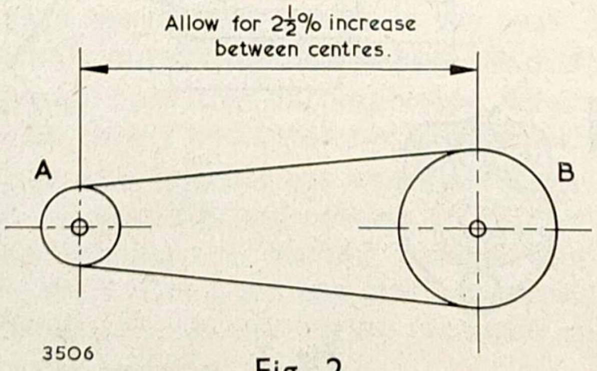


Fig. 2

11. Rotation

Standard engine rotation is clockwise when viewed from the flywheel end.

d operation

12. To prepare a new or overhauled engine for starting (Fig. 3)

(*a*) Check that the cooling system is in order and free from obstruction.

(*b*) Remove the oil filler cap and, with engine level, fill with lubricating oil to the high level mark on the dipstick. (To remove the cap, push down and twist.) Replace cap. (After a few minutes running stop the engine and top up the oil, as the level always falls slightly after the initial circulation.)

(*c*) Unscrew the nut on the air cleaner cover, remove the cover and element and dip the cover, but not the element, in a bath of clean engine oil. Allow the cover to drain. Replace the element and cover making sure that the element is correctly seated on the sealing rings.

(*d*) Lift the decompressor lever (A) and turn the engine fifteen revolutions to help circulate the oil.

(e) Fill the fuel tank and bleed the fuel system, if required.

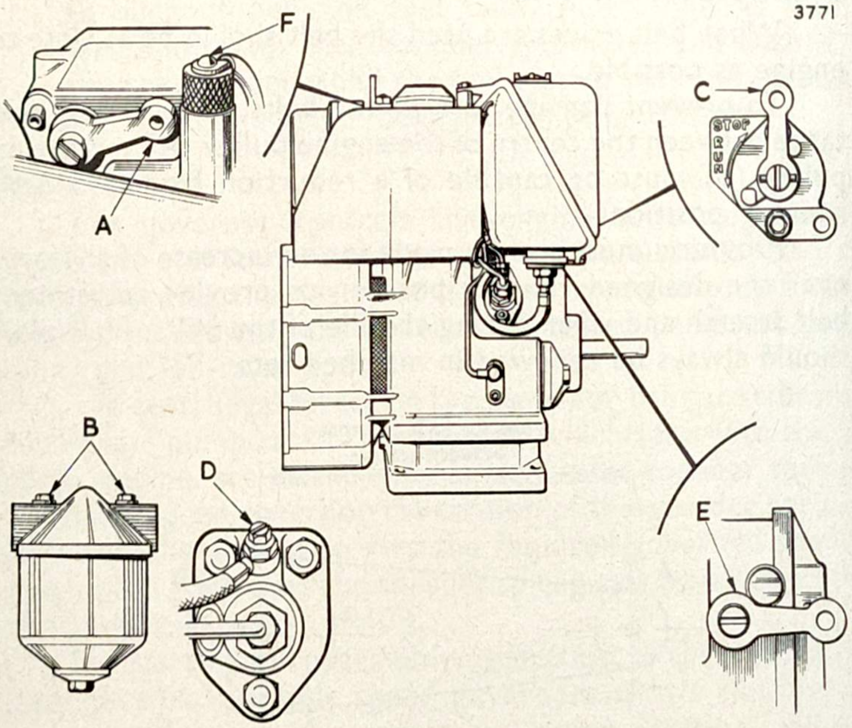


Fig. 3

13. To bleed fuel system (Fig. 3)

(*a*) Some engines are fitted with a self-bleeding fuel system and require no attention.

(*b*) If a separately mounted fuel filter is fitted, loosen the two vent screws (B) on top of the filter and keep loose until clean, bubble-free fuel leaks out. Retighten the screws.

(*c*) On engines not fitted with a self-bleeding fuel injection pump move the stop/run lever (C) to the 'RUN' position, i.e. horizontal. Loosen the vent screw (D) on the fuel injection pump and turn the engine a few times until clean, bubble-free fuel leaks out. Retighten the vent screw.

14. To start (Fig. 3)

(*a*) Remove the load from the engine.

(*b*) Move the stop/run lever (C) to the 'RUN' position, i.e. horizontal.

(*c*) If a variable speed control is fitted, set the control lever to the half speed position then push down and release the overload stop lever (E).

(*d*) If a two-speed control is fitted, set the control in the 'RUN' position.

(e) Rope starting

  (i) Turn the starting pulley in the opposite direction to the arrow until a resistance is felt. Bounce the pulley vigorously against the resistance until the injector has squeaked ten times. (This is unnecessary with a warm engine.)

  (ii) Wind the rope round the starting pulley in the direction of rotation. The end of the rope should be in the pulley from two to two-and-a-half turns.
  WARNING: THE ROPE SHOULD NOT BE WOUND ROUND THE OPERATOR'S WRIST.

  (iii) Make sure that the decompressor lever is disengaged and then pull the rope smartly until it unwinds completely from the pulley. The engine should now fire.

(*f*) 4:1 hand starting

  (i) Lift the centre boss of the starting gear.

  (ii) Engage the starting handle in the boss. The handle will not fully engage unless the boss has been lifted.

  (iii) Lift and hold the decompressor lever (A). Turn the handle slowly and listen for the squeak of the injector.

  (iv) When the injector has squeaked turn the handle as fast as possible and release the decompressor lever. Keep turning the starting handle. The engine should now start. The gears and starting handle will disengage automatically as the engine increases speed.

(*g*) Raised hand starting

  (i) Lift the decompressor lever (A) and turn the starting handle in the direction of rotation slowly until the injector is heard to squeak.

(ii) When the injector has squeaked, turn the starting handle as fast as possible. When maximum speed is reached, disengage the decompressor lever and keep turning until the engine fires.

(*h*) Electric starting

(i) Make sure that the decompressor lever is disengaged and then operate the starter switch.

(ii) Do not operate the starter motor for more than 20 seconds at a time, and leave at least 10 seconds before attempting to start again.

15. Cold starting (Fig. 3)

(*a*) Below 13°C (55°F) and if the engine is cold, it is essential to prime the engine for hand starting, and advisable if battery power is low when electric starting. Proceed as follows:

(i) Remove the priming plunger (F).

(ii) Fill the priming chamber with engine oil—NOT fuel.

(iii) Replace the priming plunger and press down.

(iv) It is advisable to keep a quantity of lubricating oil in a suitable container at room temperature for this purpose.

(v) Start in the normal manner.

(*b*) Should the engine fire and then stop, prime again and release the overload stop lever (E) before attempting to start.

(*c*) Below 0°C (32°F) and if the engine is cold, prime the engine twice.

(*d*) If under cold conditions the engine does not run up to its rated speed after starting, operate the priming plunger again while the engine is running.

(*e*) To minimise cold starting difficulties, it is a wise policy to keep the engine under cover when not in use and to ensure that an SAE 10W viscosity oil is used (see Approved Lubricants).

(*f*) Below –4°C (25°F) rope starting is not recommended.

(*g*) Below –9°C (16°F) consult *Petters Ltd of their agents* for starting instructions.

16. To stop

(*a*) It is advisable to run on light load for a few minutes before stopping.

(*b*) Move the stop/run lever to the 'STOP' position, i.e. vertical, and hold in this position until the engine stops.

17. Important don'ts

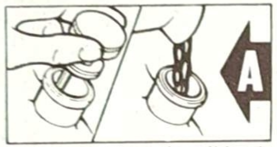
(*a*) DON'T stop the engine by means of the decompressor. This will lead to damaged valve seats and cylinder head joints.

(*b*) DON'T stop the engine by allowing the fuel tank to run dry.

AAI-ABI RUNNING MAINTENANCE CHART

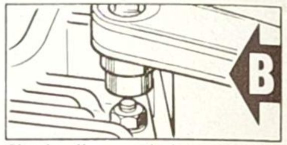
3774

DAILY

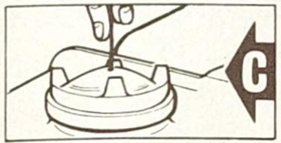


Check the lubricating oil level on the dipstick and top up if necessary.

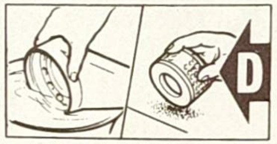
250 HOURS



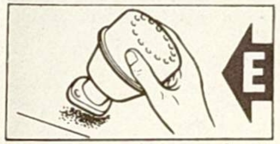
Check all nuts, bolts, etc., for tightness. (The cylinder head nuts must **NOT** be tightened when the engine is hot.)



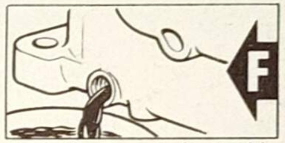
Make sure the fuel tank filler cap vent hole is clear.



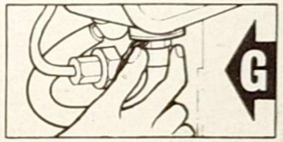
Clean the air cleaner.



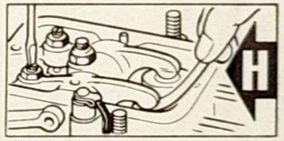
Clean out deposit from exhaust system.



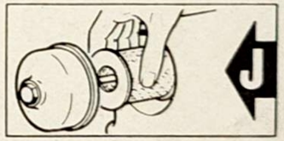
Drain the sump, flush out with flushing oil and refill with new oil.



Test the fuel system for leaks.

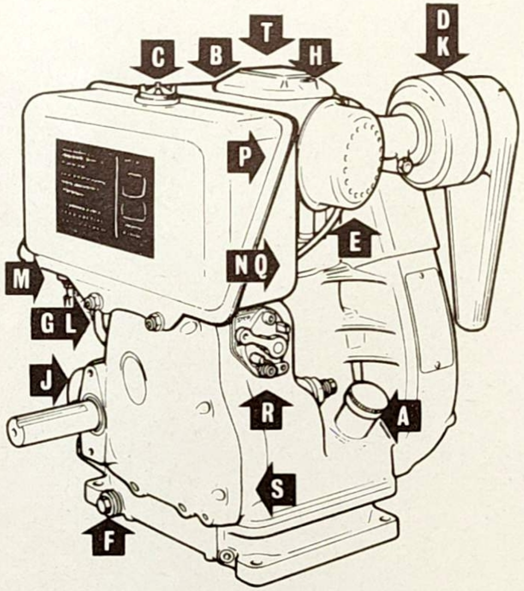


Check the valve clearance and adjust if necessary.



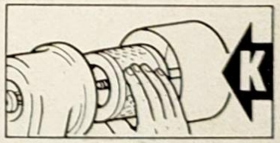
Fit new lubricating oil filter element and joint ring.

This chart has been designed to help you. Its correct application will ensure maximum service from your Petter engine.



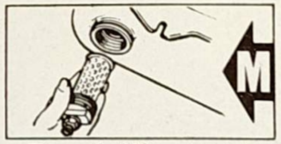
Keep cooling system free from obstruction. Use only the lubricants approved by Petter

500 HOURS

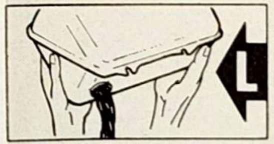


Fit new air cleaner element.

1,000 HOURS

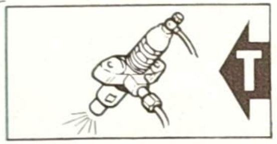


Fit new fuel filter element.

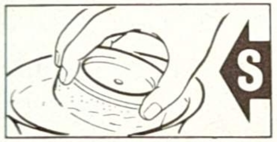


Clean out the fuel tank thoroughly.

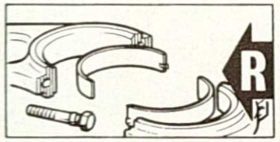
2,000 HOURS



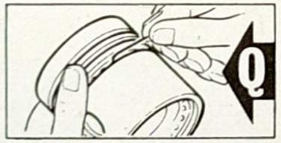
Remove the injector and test spray.



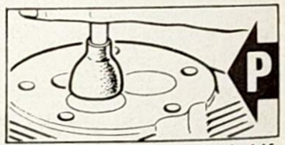
Clean the oil pump strainer.



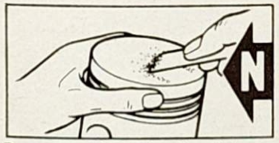
Examine the crankshaft bearings and renew if clearance is excessive.



Clean the piston oil return holes. Check cylinder bore wear.



Examine the valves and grind if necessary.



Remove cylinder head and decarbonise.

(c) DON'T remove or alter the setting of the overload stop or operate the overload stop lever when the engine is running. This will cause overheating, excessive wear and possibly piston seizure.

(d) DON'T forget to grease the starting handle shaft. Make sure the starting handle can be freely withdrawn.

e running maintenance

18. Clutch

If a *Petter* clutch is fitted it should be adjusted in accordance with the instructions given under General Maintenance.

19. Daily

(*a*) Check lubricating oil and top up if necessary.
(*b*) Check that the cooling system is in order and free from obstruction.

NOTE:
The following maintenance recommendations are for average operating conditions. Under very dusty conditions, air cleaners, lubricating oil and fuel filters will require more frequent attention. Decarbonising may be required more frequently when engines are running on light load for long periods.

20. Every 50 hours

(*a*) Clean the air cleaner (oil bath type).

21. Every 250 hours

(*a*) Check all nuts, bolts, etc., for tightness. (The cylinder head nuts must NOT be tightened when the engine is hot.)
(*b*) Make sure the fuel tank filler cap vent hole is clear.
(*c*) Clean the air cleaner (paper element type).
(*d*) Clean out deposit from exhaust system.
(*e*) Drain the sump, flush out with flushing oil and refill with new oil. (Paraffin may be used if flushing oil is unobtainable but the engine must not be run with paraffin in the sump.)
(*f*) Test the fuel system for leaks.
(*g*) Check the valve clearance and adjust if necessary.
(*h*) Fit new lubricating oil filter element and joint ring.
(*j*) Lubricate the speed control linkage.
(*k*) Lubricate the 4:1 or raised hand starting if fitted.

22. Every 500 hours

(*a*) Fit new air cleaner element (paper element type).

23. Every 1000 hours

(*a*) Clean out the fuel tank thoroughly.
(*b*) Fit new fuel filter element.

24. Every 2000 hours

(*a*) Decarbonise.
(*b*) Clean out piston oil return holes. Check cylinder bore wear.
(*c*) Examine the crankshaft bearings and renew if clearance is excessive.
(*d*) Clean the oil pump strainer.
(*e*) Remove the fuel injector and test spray. If in order replace without further interference.

f general maintenance

25. Decarbonising

A carbon deposit forms on piston and cylinder heads and the presence of an excessive carbon deposit is usually indicated by a dirty exhaust and a falling off of power.

Decarbonising necessitates the removal of the cylinder head. followed by the removal of all carbon and the grinding in of the valves. These operations are described in subsequent paragraphs,

Sets of joints are obtainable from *Petters Ltd or their agents.*

26. To remove cylinder head

(*a*) Remove the cylinder cowling and fuel tank.
(*b*) Remove the crankcase-to-rocker-box oil pipe.
(*c*) Disconnect fuel pipes and place in clean fuel (see Fuel System).
(*d*) Remove rocker cover.
(*e*) Remove the exhaust silencer or manifold, and the air cleaner and manifold assembly.
(*f*) Remove the fuel injector. Cover the holes in the injector against admission of dirt, etc.
(*g*) Remove the rocker assembly and withdraw the push rods.
(*h*) Remove the cylinder head nuts and lift off the cylinder head and push rod tubes.

27. To remove valves

(*a*) Hold the valve on the seat and depress the valve spring cap and remove the split collets. Valve, spring, spring plate and cap can now be removed.

28. To remove carbon

(*a*) Turn crankshaft until piston is at top of its stroke.
(*b*) Scrape carbon from the cylinder head and top of the piston with a broad blunt tool. Emery cloth must NOT be used. Do not allow carbon dust to fall between the piston and the cylinder bore.

(c) Thoroughly clean out the exhaust and inlet ports and manifolds.
(*d*) Make sure that the recesses at the end of the valve guide bores are free from carbon.
(e) Thoroughly clean the valves and examine the valve seats. If these show signs of pitting, they should be ground in.
(*f*) Make sure the valves are seating properly. Leaking valves cause loss of compression and difficult starting.
(g) DO NOT remove the air cell from the cylinder head. If a carbon deposit has formed in the air cell nozzle, it may be cleaned with a soft piece of wire.

29. To remove valve guides

(*a*) EXTREME CARE AND CLEANLINESS is essential at all times when removing or replacing the valve guides.
(*b*) Thoroughly wash the cylinder head with petrol or paraffin to ensure that all carbon, oil and dirt has been removed.
(c) To remove the valve guides, place the cylinder head in boiling water for two minutes. Support the head on blocks at least $\frac{1}{2}$in (13mm) thick, to prevent the valve guides bottoming. Press out the guides from the valve seat side with the aid of a hand press and punch.
(*d*) If a press is not available, a drift may be used, but SPECIAL CARE MUST BE TAKEN to avoid the drift slipping, scoring or otherwise damaging the bores.
(e) DO NOT USE EXCESSIVE FORCE if heavy resistance is encountered, but replace the cylinder head in boiling water for a further two minutes.
(*f*) When pressing out the guides ensure that the punch does not score or damage the bores in any way. Failure to observe this precaution may result in the new guides being loose in the cylinder head.

30. To replace valve guides

(*a*) Before fitting new guides, ensure the bores in the cylinder head and the body of the guides are clean.
(*b*) Place the cylinder head in boiling water for two minutes, enter the guides squarely in the bores from the rocker box side, and press home to the shoulder.
(c) If a press is not available, a drift may be used, but SPECIAL CARE MUST BE TAKEN to avoid the drift slipping, scoring or otherwise damaging the bores.
(*d*) The valve guides MUST NOT BE REAMED.
(*e*) Grind in the valves.

31. To grind in valves

(*a*) Care must be taken that the valves are returned to their correct seating for this operation.

(*b*) Place a very small quantity of grinding paste evenly around the valve seat and insert the valve. Partially rotate the valve backwards and forwards on its seating, exerting a gentle but firm pressure.

(*c*) Periodically lift the valve from its seating and give it half a turn, thus ensuring that the grinding paste is evenly spread.

(*d*) It is unnecessary to continue grinding once the faces of the valve and its seating have a clean, even, matt-surfaced appearance. A polished surface must not be expected and is unnecessary.

(*e*) Wash out the ports thoroughly with petrol or paraffin making sure that all traces of grinding paste are removed from the valves and guides.

(*f*) Replace the valves and rotate them backwards and forwards a few times. If the valves have been correctly ground a thin polished line will appear all round the seat.

32. To replace cylinder head

(*a*) Generally reverse the instructions for removal and dismantling. The rocker bushes and push rod ends should be smeared with molybdenum-disulphide grease before assembly.

(*b*) It is IMPORTANT that the exhaust and inlet valves be returned to their correct positions.

(*c*) If the valves are distorted or very badly pitted, fit new ones.

(*d*) If new valves or guides are fitted, the valves must be ground in.

(*e*) When replacing the cylinder head, a new cylinder head gasket and push rod tube seals should be fitted. Failure to observe this precaution may lead to oil leaks.

(*f*) As these engines are fitted with long through studs from the crankcase to the cylinder head it is MOST IMPORTANT that the cylinder head nuts are correctly tightened and in the right sequence.

(*g*) Tighten the cylinder head nuts using a torque spanner set to the figures shown under Technical Data. Proceed as follows:

(i) Screw down each cylinder head nut until finger tight.

(ii) Tighten each nut a quarter of a turn at a time working diagonally across the cylinder head until all the nuts are tight.

(iii) After approximately 20 hours running check again for tightness.

(*h*) Tighten the injector stud nut using a torque spanner set to the figure shown under Technical Data. See 'To replace fuel Injector'.

33. To adjust valve rockers (Fig. 4)

(*a*) To adjust the clearance, set the engine with valves closed (TDC of firing stroke), loosen the locknut (A) and turn the rocker adjusting screw (B) with a screwdriver. Measure the gap with a feeler gauge, and when the correct setting is obtained (see Technical Data) retighten the locknut. Recheck the gap.

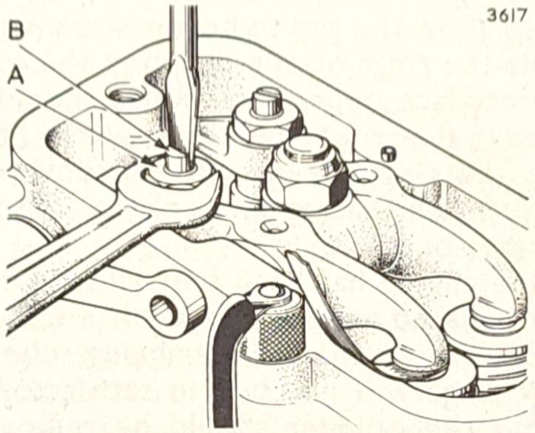


Fig. 4

(*b*) IMPORTANT. The cylinder head must be firmly bolted in position, with all nuts finally tightened, before the rocker clearances are adjusted.

34. To remove cylinder and piston

(*a*) Remove cylinder head.
(*b*) Lift the cylinder off the crankcase and draw it off the piston.
(*c*) To remove piston, take out one gudgeon pin circlip and push out gudgeon pin. If the gudgeon pin is a tight fit in the piston, wrap the piston in a cloth soaked in hot water. After a few minutes the gudgeon pin will be released and can be pushed out.

35. Cylinder maintenance

(*a*) When the cylinder bore wear has reached the maximum (see Technical Data) the cylinder should be bored out and an oversize piston and rings fitted.
(*b*) The cylinder should be rebored and honed to the sizes shown under Technical Data.

36. Piston maintenance (Fig. 5)

Excessive lubricating oil consumption, loss of compression and knocking are signs that a piston may need attention.

(*a*) If the ring gaps are excessive (see Technical Data) the rings should be renewed. To measure the gaps remove the rings from the piston noting the order of assembly and which ring face is uppermost.

(*b*) Remove all the carbon deposit from the rings and ring grooves. The small holes (A) in scraper ring grooves should receive attention as their purpose is to return excess oil to the sump.

(*c*) Insert the piston into the cylinder bore with the crown towards the bottom end of the bore to about $\frac{1}{2}$in (13mm) from the bottom edge. Insert the rings one at a time, pushing each ring hard up against the piston crown to ensure that it is level in the cylinder bore. Withdraw the piston sufficiently to allow the gap to be measured with a feeler gauge.

(*d*) Assemble the rings on the piston in the correct order with the correct face uppermost. Rings should not be slack or stuck fast in the groove. With the piston held in a horizontal position the rings should not fall downwards unless the piston is shaken. This applies only to a piston and rings free from grease or oil.

(e) When the engine has been fully run in, the bore will have a highly polished and very hard surface. If new piston rings are fitted without the cylinder being rebored or resleeved, the new rings will not bed in satisfactorily. Under these conditions the cylinder should be removed and the hard polished bore lightly roughened using a medium grade emery cloth. The roughening should be carried out radially by hand and should be sufficient only to produce a matt surface on the bore. Alternatively, a suitably sized deglazing tool of the rotary brush type with silicone-carbide tips may be used provided method used is in accordance with manufacturers instructions. After this treatment the cylinder must be thoroughly washed in petrol or paraffin to remove all traces of carborundum.

(*f*) Some AA1 engine pistons may have a second oil scraper ring groove below the gudgeon pin. No ring is fitted to this groove.

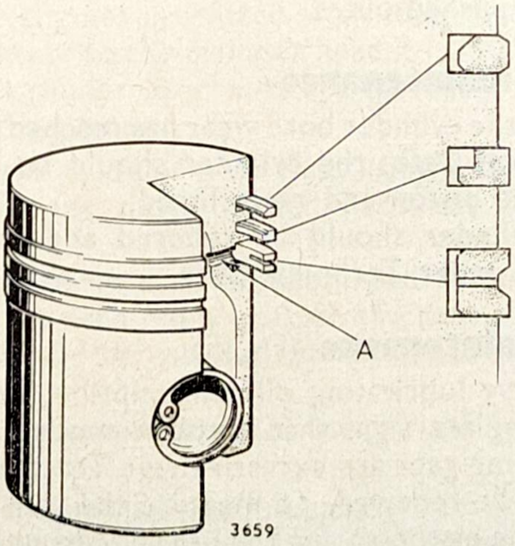


Fig. 5

(g) To allow the piston rings to bed in satisfactorily it is recommended that the engine be run on half load whenever possible after overhaul.

37. To replace cylinder and piston

(*a*) Take care that the piston ring gaps are not in line but well distributed around the piston circumference.

(*b*) Replace the shims between the cylinder and crankcase. The thickness of the shims controls the bumping clearance between the piston and cylinder head at TDC.

(c) Before completing reassembly check the bumping clearance (see Technical Data) as follows:

- (i) Insert a length of lead wire or soft solder through the injector port in the cylinder head. Pull through sufficient to allow approximately 1in (25mm) to be positioned flat on the cylinder head between the inlet and exhaust valves. Wind any surplus wire around the injector studs.
- (ii) Replace the cylinder head, fitting a new gasket, and tighten the nuts in the correct sequence with a torque spanner.
- (iii) Turn the engine over TDC and then carefully remove the wire.
- (iv) Measure the thickness of the now flattened wire with a micrometer. If the clearance is outside the limit, adjust by changing one or more of the shims at the base of the cylinder, and recheck the bumping clearance.

(*d*) After completing reassembly, check the valve rocker clearance.

38. To examine connecting rod

(*a*) Drain the sump.

(*b*) Remove the cylinder head, cylinder and sump.

(*c*) Grasp the large end of the connecting rod and check for undue play or shake in the bearing. The flywheel should be rocked backwards and forwards during this operation.

(*d*) Check that the large end bolts are tight (see Technical Data).

(*e*) Check for undue wear in the small end bush by rocking the piston whilst holding the connecting rod firmly.

39. To remove connecting rod

(*a*) Remove the cylinder head and cylinder.

(*b*) Drain the oil from the sump.

(*c*) Remove the sump.

(*d*) Unscrew the large end bolts and withdraw the connecting rod and piston assembly, being careful to note in which position the bearing halves are fitted.

40. Connecting rod maintenance

(*a*) When fitting a small end bush take care that the oil hole coincides with that in the connecting rod and that the bush enters the connecting rod squarely. In the absence of a press, a block of wood and mallet may be used for driving it home.

(*b*) New small end bushes are supplied with a reaming allowance, and after fitting must be reamed to the size shown under Technical Data.

(*c*) Large end bearings are of the precision thin wall steel backed type and consist of two half shells lined with bearing metal. They should be replaced in their original positions.

(*d*) New bearings are machined to give the required fit when in position and should not be scraped or bedded in, neither should shims of any description be fitted. If the faces of the connecting rod or its cap are filed the rod becomes useless regarding replacement bearing shells. When fitting make sure that the connecting rod bore and the outside of shells and their split face are clean.

(*e*) Connecting rods and caps are stamped with an assembly serial number and care must be taken that numbers are correctly assembled and on the same side.

(*f*) Undersize bearings are obtainable from *Petters Ltd or their agents.*

41. To replace connecting rod

(*a*) Generally reverse the instructions for removal, making sure that the connecting rod cap is away from the dipstick side of the engine.

(*b*) Tighten the large end bolts using a torque spanner set to the figure shown under Technical Data.

(*c*) Do not over-tighten the large end bolts or the bearing may distort. If a torque spanner is not available, the bolts may be tightened using a moderate force on a spanner gripped approximately 8in (200mm) from the bolt.

(*d*) When replacing the cylinder and cylinder head, check the bumping clearance and valve rocker clearance.

42. 4:1 hand starting (flywheel end)

(*a*) To remove

- (i) Remove the starting gearwheel guard.
- (ii) The gearwheels can now be greased using a high melting point grease. The sliding plate assembly, locating screws and starting handle shaft recess can be lightly oiled without further dismantling.
- (iii) Remove the mounting plate assembly from the bellhousing if necessary, by removing the two capscrews and two setscrews.
- (iv) Remove the starting gearwheel retaining clip and circlip, and remove the gearwheel.

(*b*) To replace

(i) Generally reverse the instructions for removal.

(ii) If the mounting plate has been removed, and the sliding plate assembly dismantled, tighten the locating screws, capscrews and setscrews using a torque spanner set to the figure shown under Technical Data.

(iii) After assembly check that load required to lift the gearwheel into mesh, using a spring gauge, is 15 to 20 lb (6·8 to 9·1 kg) for engines running between 1000 and 1800 rev/min, and 24 to 28 lb (10·9 to 12·7 kg) for engines running above 1800 rev/min.

(iv) The gearwheel retaining clip can be adjusted by setting the bracket to give the required loads.

(v) Replace the guard.

43. 4:1 hand starting (gear end)

(*a*) To remove

(i) Remove the starting gear guard.

(ii) The gearwheels can now be greased using a high melting point grease. The sliding plate assembly, locating screws and starting handle shaft recess can be lightly oiled without further dismantling.

(iii) Remove the starting gearwheel retaining clip and circlip, and remove the gearwheel.

(iv) Remove the crankshaft extension shaft gearwheel retaining screw and plate, and withdraw the gearwheel which is keyed to the shaft.

(v) Remove the screws securing the sliding plate and remove the plate from the return spring.

(vi) Remove the remaining screws from the mounting plate and remove the mounting plate and guard from the engine gear cover.

(*b*) To replace

(i) Generally reverse the instructions for removal.

(ii) When replacing the return spring, ensure that it is correctly located in the mounting plate and the spacer and washer are fitted.

(iii) Ensure that the return spring is located in the sliding plate before positioning and replacing the locating screws.

(iv) Ensure that the extension shaft key is fitted before replacing the gearwheel.

(v) Before replacing the starting gearwheel, tighten all the locating screws and the crankshaft extension gearwheel using a torque spanner set to the figure shown under Technical Data.

(vi) Replace the starting gearwheel, retaining clip and guard.

44. Raised hand starting

(*a*) To remove

- (i) Loosen the starting handle shaft retaining screw, but do not remove it.
- (ii) Remove the circlip on the top shaft, and take off the washers.
- (iii) Remove the five capscrews retaining the outer chain housing and draw it off the dowels.
- (iv) Remove the retaining screw from the top shaft and remove the starting handle shaft, upper chainwheel, chainwheel retaining shaft and chain.
- (v) Remove the outer circlip and washer from the bottom shaft and gently slide the chainwheel and clutch assembly off the shaft. Remove the inner circlip.
- (vi) Remove the two remaining capscrews from the back of the inner chain housing and remove the housing from the spigot.

(*b*) Maintenance

- (i) Thoroughly clean and inspect all parts, paying particular attention to wear on the bushes, clutch and oil seal.
- (ii) Before replacement, immerse the chain and liberally oil the chainwheels with *Shell Ensis 20* oil or equivalent, and pack the clutch with water resistant grease.

(*c*) To replace

- (i) Generally reverse the instructions for removal.
- (ii) IT IS IMPORTANT that the chainwheel and clutch assembly is fitted the correct way round. When fitting this unit ensure that when turned clockwise the clutch binds, and when turned anti-clockwise the clutch is free.
- (iii) Tighten the starting handle shaft retaining screw using a torque spanner set to the figure shown under Technical Data.

45. To remove flywheel

(*a*) Remove any fittings from the bellhousing and flywheel.

(*b*) Secure the flywheel by inserting a hexagon wrench key or steel rod through the timing hole in the bellhousing, and locating it in the hole in the flywheel periphery. This rod must not be loose, but a good fit in the flywheel hole.

(*c*) Bend back the tabwasher and remove the flywheel retaining nut.

(*d*) Remove the securing rod.

(*e*) A simple extractor will be required to remove the flywheel, as it is fitted on a tapered shaft and located by a key. Make sure that the flywheel fan is not damaged when removing the flywheel.

(*f*) Remove the flywheel locating key.

46. To replace flywheel

(*a*) Generally reverse the instructions for removal.

(*b*) Ensure that the flywheel locating key is replaced in the crankshaft before fitting the flywheel.

(*c*) A new tabwasher must be fitted before tightening the flywheel retaining nut. Tighten the flywheel nut using a torque spanner set to the figure shown under Technical Data.

(*d*) When the nut is tight, knock up the tabwasher.

(*e*) If a 4:1 hand starting arrangement is fitted, the gearwheels should be greased and the sliding plate, locating screws and the starting handle shaft recess oiled. Tighten the flywheel extension gearwheel bolts using a torque spanner set to the figure shown under Technical Data.

47. To remove crankshaft

(*a*) Remove the cylinder head, cylinder, connecting rod and flywheel.

(*b*) Remove any starting arrangement or fitting from the gear cover.

(*c*) Remove the gear cover. The cover is dowelled to the crankcase.

(*d*) Remove the crankshaft extension shaft at the gear end, if fitted.

(*e*) Remove the crankshaft gearwheel retaining bolt. Withdraw the gearwheel with a simple extractor.

(*f*) Remove the nuts retaining the flywheel end main bearing housing. Remove the housing taking care not to damage the oil seal.

(*g*) Withdraw the crankshaft by pulling towards the flywheel end.

48. Crankshaft maintenance

(*a*) Carefully examine the bearing journals and crankpin. They should be free from score marks and ovality should not exceed the maximum (see Technical Data).

(*b*) If these defects are present the crankshaft should be reground to the diameter shown under Technical Data and undersize bearings fitted.

(*c*) Carefully clean out the oil holes and make sure they have radiused edges.

49. Main bearing maintenance

(*a*) Main bearings are of the precision thin wall steel backed sleeve type lined with bearing metal.

(*b*) When removing a gear end bearing from the crankcase or a flywheel end bearing from the bearing housing, heat the crankcase or bearing housing to a temperature of 93/120°C (200/250°F) before pressing out the bearing.

(c) When fitting a bearing, the crankcase or bearing housing should again be heated as above and the outer surface of the bearing should be smeared with molybdenum-disulphide grease or tallow before pressing in. It is an advantage if the bearing can be placed in a domestic type refrigerator for a time before fitting.

(d) Do not remove the bearings unnecessarily or their tightness in the crankcase or bearing housing may be affected. It is not advisable to remove the bearings more than five times.

(e) When fitting a bearing take care that it enters squarely.

(f) New bearings are machined to give the required fit when in position and should not be scraped or bedded in, neither should shims of any description be fitted.

(g) Undersize bearings are obtainable from *Petters Ltd or their agents.*

50. To replace crankshaft and time engine (Fig. 6 & 7)

(*a*) Generally reverse the instructions for removal.

(*b*) Fit new bearings if the old ones have excessive clearance or show signs of the metal having run.

(c) Make sure the main bearing housing is correctly fitted with the oil drain hole at the bottom.

(*d*) When fitting new thrust washers, be sure that the grooved sides are away from the bearing housing and that the tongues (A) are located in their respective recesses. Fit new pins (B).

(e) Check the end float (Y) and if excessive fit new thrust washers (see Technical Data).

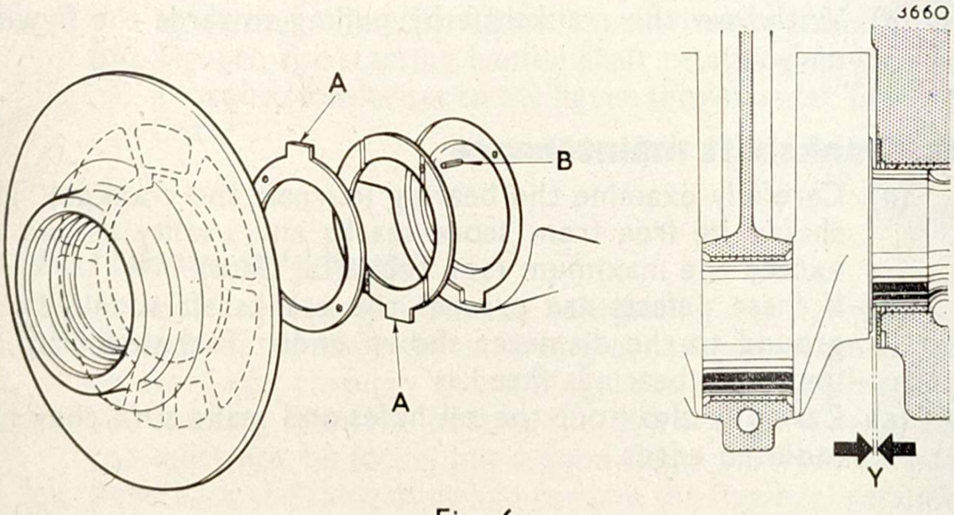


Fig. 6

(*f*) When assembling the gearwheels make sure that the teeth marked with dots are in their relative positions.

(g) Tighten the crankshaft gearwheel retaining screw and extension shaft screws, if fitted, using a torque spanner set to the figure shown under Technical Data.

(*h*) Replace the flywheel.

(*j*) If a starting arrangement is fitted to the gear cover, maintenance should be carried out before replacing.
(*k*) Before completing reassembly, check the bumping clearance.

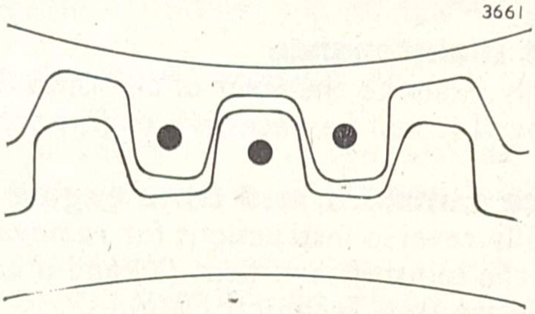


Fig. 7

51. To remove camshaft (Fig. 8)

(*a*) Drain oil from the sump.
(*b*) Drain and remove the fuel tank. Remove the fuel pipes placing them in clean fuel (see 'Fuel system'). Remove fuel injection pump. Cover holes in injector against admission of dirt, etc.
(*c*) Remove any starting arrangement or fitting from the gear cover.
(*d*) Remove the gear cover.
(*e*) Remove the rocker cover, rocker support and rocker assembly and withdraw the push rods.
(*f*) Turn the engine onto its side to prevent the tappets from falling into the sump.
(*g*) Remove the extension shaft from the camshaft gearwheel, if fitted.
(*h*) Remove the screws (A) retaining the camshaft thrust plate. These are accessible through holes in the gearwheel. Withdraw the camshaft and gear wheel assembly from the gear end of the engine.

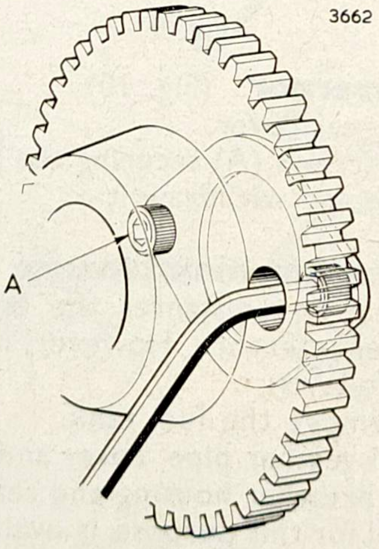


Fig. 8

(*j*) The gearwheel is a tight fit on the camshaft. To fit a new thrust plate remove the gearwheel retaining bolt and press the shaft from the gearwheel. The gearwheel is keyed to the shaft.

52. Camshaft maintenance

(*a*) Carefully examine the faces of the cams. If these are worn or chipped it will be necessary to fit a new camshaft.

53. To replace camshaft and time engine (Fig. 7 & 9)

(*a*) Generally reverse instructions for removal.
(*b*) Check the camshaft end float (Y) and if excessive fit a new thrust plate (see Technical Data).
(c) When assembling the gearwheels make sure that the teeth marked with dots are in their relative positions.
(*d*) Tighten the camshaft gearwheel retaining screw and extension shaft screws, if fitted, using a torque spanner set to the figure shown under Technical Data.
(e) Retime the fuel injection pump and adjust the valve clearances.

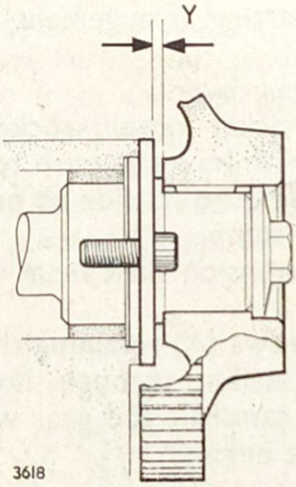


Fig. 9

54. To remove governor (Fig. 10)

(*a*) Remove the gear cover.
(*b*) Remove the screws (A) securing the governor assembly to the crankcase and withdraw it.

55. Crankcase breather maintenance

Under normal circumstances the breather assembly will not require maintenance. However, if removal is necessary proceed as follows:

(*a*) Drain and remove the fuel tank.
(*b*) Remove the breather pipe, cover and valve.
(c) Remove the breather housing and seal from the crankcase. A special tool for this purpose is available from *Petters Ltd or their agents*.

(d) Thoroughly clean all parts in paraffin or clean fuel.

(e) Examine the seal and valve for damage and replace if necessary.

(f) When fitting the cover, ensure that the pipe connection is parallel to the crankshaft and facing the flywheel end.

56. To remove governor linkage (Fig. 10)

(a) Remove the governor.

(b) Remove the gearwheel from the camshaft.

(c) Move the stop/run lever (B) to the 'RUN' position, i.e. horizontal.

(d) Remove the screws (C) securing the governor stop cover (D), or speed control bracket if fitted and remove it.

(e) Loosen the governor bracket screw (E) and remove the bracket (F), speeder spring and speeder spring plunger.

(f) Remove the breather assembly (G) and withdraw the shaft (H) and fuel pump operating lever (J).

(g) Remove the pin (K) securing the overload stop lever (L) if fitted, and remove the lever. DO NOT loosen the screw (M) clamping the overload stop cam (N) to the spindle. The cam is set by *Petters Ltd* and should not be disturbed unless a new fuel pump is fitted (see instructions given under 'To fit new fuel injection pump').

(h) Remove the overload stop cam and spindle assembly and the return spring (P).

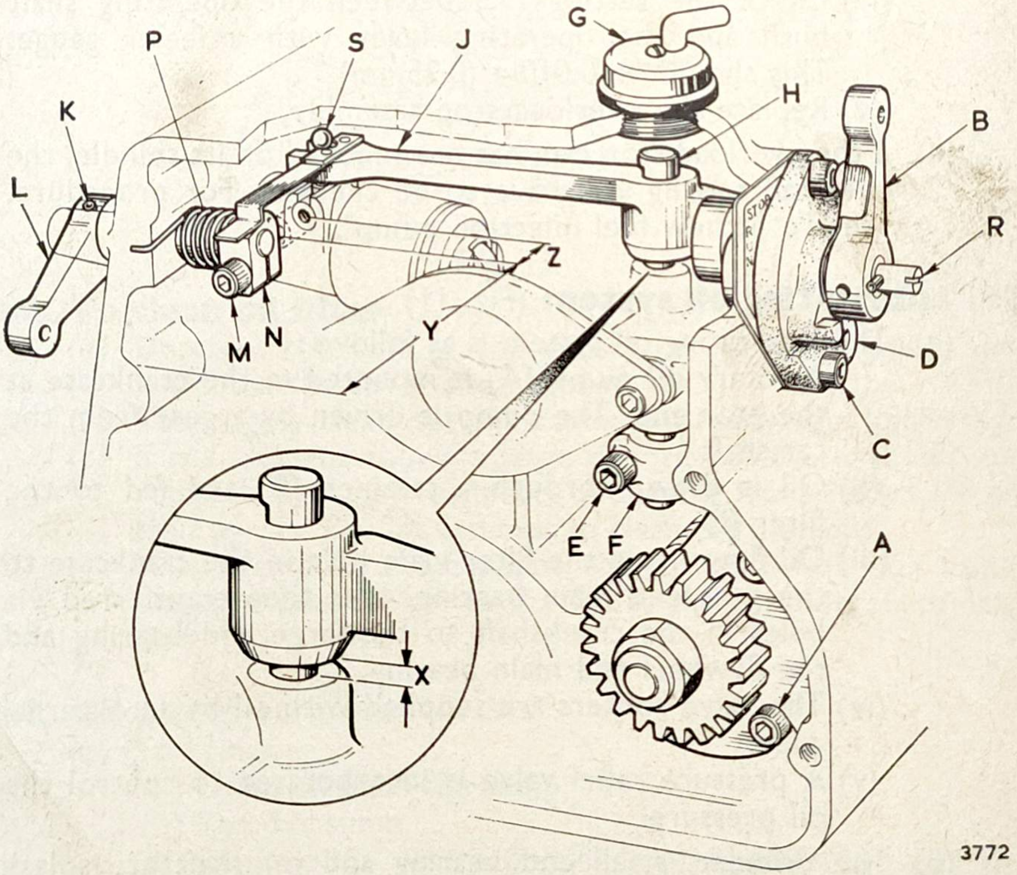


Fig. 10

57. Governor and linkage maintenance (Fig. 10)

(*a*) Thoroughly clean all parts in paraffin or clean fuel, paying particular attention to all bearings and governor balls.

(*b*) Examine the faces of the governor sliding and rotating housings for signs of wear. If worn, the governor assembly must be replaced.

(*c*) If oil leaks at the overload stop spindle or the stop/run lever spindle (R), carefully remove the spindle and renew the oil seal. When refitting the spindle ensure that it is free from burrs.

58. To replace governor and linkage (Fig. 10)

(*a*) Generally reverse the instructions for removal.

(*b*) Ensure that the fuel pump lever fork end is correctly located on the fuel pump rack ball (S).

(*c*) Before replacing the overload stop assembly, adjust the governor linkage to the correct position as follows:

- (i) With the governor bracket screw (E) loose, make sure that the governor bracket fork ends are hard against the governor thrust bearing when the faces of the governor sliding and rotating housings are together.
- (ii) Push the fuel pump operating lever as far as possible to the fuel pump fully open position.
- (iii) Tighten the governor bracket locking screw.
- (iv) Check the setting (X) between the operating shaft bush and the operating lever with a feeler gauge. This should be 0·010in (0·25mm).
- (v) Replace the overload stop assembly.

(*d*) If the overload stop cam has been moved on its spindle, the overload setting will have to be checked. For procedure, see 'To fit new fuel injection pump'.

59. Lubricating oil system (Fig. 11)

(*a*) The lubricating oil system is as follows:

- (i) A rotary oil pump (A) is mounted in the crankcase at the gear end. The pump is driven by a gear from the camshaft.
- (ii) Oil is drawn through a strainer (B) and fed to the filter (C).
- (iii) Oil flows from the filter via a hole in the crankcase to the gear end main bearing. It is then transferred via holes in the crankshaft to the large end bearing and the flywheel end main bearing.
- (iv) The valve rockers are supplied with oil by an external pipe.
- (v) A pressure relief valve is incorporated to control the oil pressure.

(*b*) The cylinder, small end bearing and camshaft are splash lubricated.

(c) The crankcase can be drained by removing the plug at the bottom of the sump.

(d) Oil must always be CLEAN and containers, funnels, etc. must be kept in a spotless condition. Use only approved oil. Cheap, unsuitable or dirty oil will cause trouble.

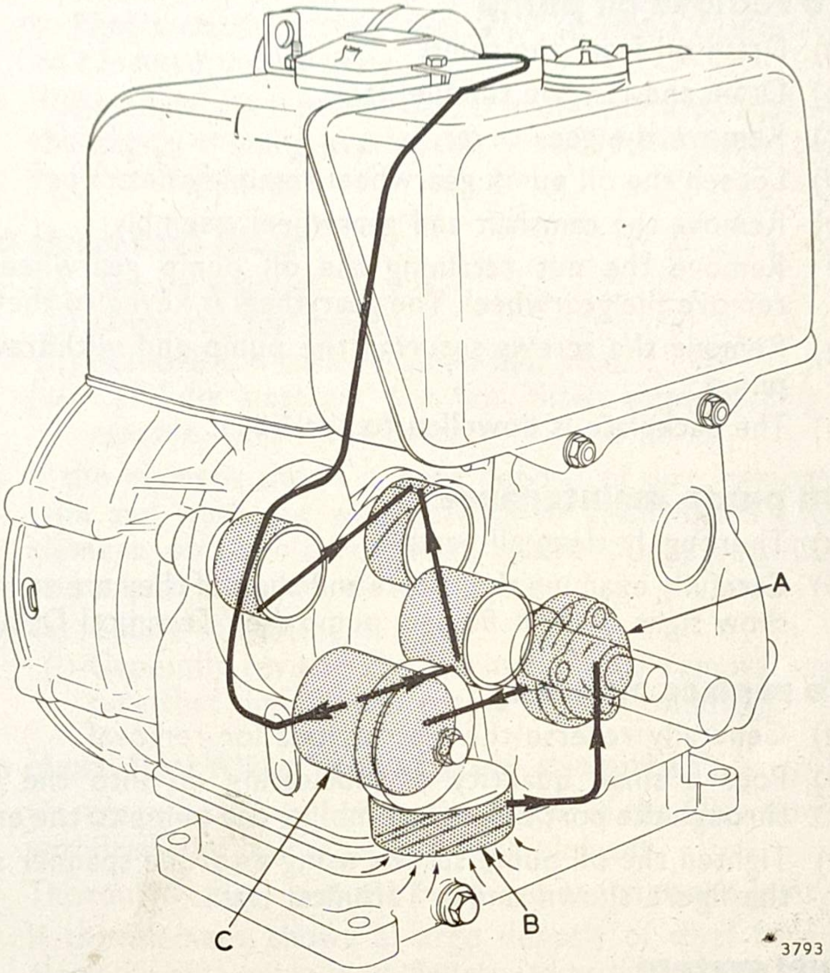


Fig. 11

60. To clean oil filter

(*a*) Unscrew the bolt at the centre of the filter cover and withdraw the cover and element.

(*b*) Thoroughly clean out the cover and renew the joint ring.

(*c*) If the element shows a large deposit of dirt, it should be replaced by a new element, obtainable from *Petters Ltd or their agents*. Do not attempt to clean the element.

(*d*) When replacing the element, tighten the centre bolt using a torque spanner set to the figure shown under Technical Data.

61. Oil pump strainer

(*a*) To remove

(i) Drain oil from the sump.

(ii) Remove sump.

(iii) Remove the centre bolt and spring plate and remove the strainer.

(*b*) To clean, wash the strainer in clean paraffin or fuel.

(*c*) To replace, generally reverse the instructions for removal, making sure that the strainer is correctly seated in the sump.

62. To remove oil pump

(*a*) Drain oil from the sump.

(*b*) Drain and remove the fuel tank.

(*c*) Remove the gear cover.

(*d*) Loosen the oil pump gearwheel retaining nut.

(*e*) Remove the camshaft and gearwheel assembly.

(*f*) Remove the nut retaining the oil pump gearwheel and remove the gearwheel. The gearwheel is keyed to the shaft.

(*g*) Remove the screws securing the pump and withdraw the pump.

(*h*) The backplate is dowelled to the body.

63. Oil pump maintenance

(*a*) Thoroughly clean all parts.

(*b*) Carefully examine the rotors and shaft. If they are scored or show signs of wear fit new pump (see Technical Data).

64. To replace oil pump

(*a*) Generally reverse the instructions for removal.

(*b*) Pour a small quantity of lubricating oil into the pump through the port before assembling the pump to the engine.

(*c*) Tighten the oil pump screws using a torque spanner set to the figure shown under Technical Data.

65. Fuel system

(*a*) Fuel from the tank flows through a filter to the injection pump which supplies it under high pressure to the injector.

(*b*) A small amount of fuel is always leaking back along the injector nozzle needle and this is returned to the fuel system by a pipe.

(*c*) The quantity of fuel injected during each cycle is very small and the fuel injection equipment is manufactured to very fine limits. IT REQUIRES EXTREME CARE AND ABSOLUTE CLEANLINESS IN HANDLING.

(*d*) Should any part of the fuel system, including pipes, be removed from the engine, it should be placed in a clean container which is filled with clean fuel. NO FILING, GRINDING, SCRAPING OR SAWING SHOULD BE CARRIED OUT WITHIN A FEW YARDS OF DISMANTLED FUEL INJECTION EQUIPMENT.

(e) Replace the equipment wet. No rag, cloth or waste should touch it.

(*f*) Unless the user has been trained in the care and repair of fuel injection equipment, he should not dismantle it in any way other than as described in subsequent paragraphs.

(*g*) Fuel pumps and injectors should be returned to *Petters Ltd or their agents* for repair or replacement. Users are advised to keep a nozzle in their spares kit so that a faulty one can be renewed immediately.

(*h*) If the exhaust becomes dirty, it is an indication that either the engine is being overloaded or the fuel injection system requires servicing.

66. To clean fuel filter

(*a*) To remove element

- (i) Drain the fuel tank.
- (ii) Remove the tank-to-pump fuel pipe.
- (iii) Carefully unscrew the fuel filter element plug and remove it from the tank.

(*b*) If the element shows a large deposit of dirt, remove the tank and wash out with paraffin or clean fuel. Fit a new element, obtainable from *Petters Ltd or their agents*. Do not attempt to clean the element.

(*c*) To replace the element

- (i) Generally reverse the instructions for removal making sure that the element seal is in good condition.

67. To clean fuel filter (separately mounted)

(*a*) Unscrew the clamp bolt at the centre of the filter bowl and withdraw the bolt complete with element.

(*b*) Thoroughly clean out the bowl and examine the joint ring.

(*c*) If the element shows a large deposit of dirt, fit a new element, obtainable from *Petters Ltd or their agents*. Do not attempt to clean the element.

(*d*) It is advisable to fit a new joint ring when the element is changed.

(*e*) Reassemble the filter.

(*f*) Bleed the fuel system.

68. To remove fuel injection pump

(*a*) Drain the fuel tank and remove.

(*b*) Remove the cowling.

(*c*) Remove the tank-to-pump and pump-to-injector fuel pipes.

(*d*) Remove the pump, noting the number and total thickness of shims between the fuel pump and crankcase.

69. To dismantle fuel injection pump (Fig. 12)

NOTE: Fuel injection pumps fitted to all variable speed engines are subjected to special calibration by the manufacturers and only the delivery side may be dismantled. The pump/control side must NOT be dismantled and should be returned to the manufacturers or to *Petters Ltd or their agents* for servicing.

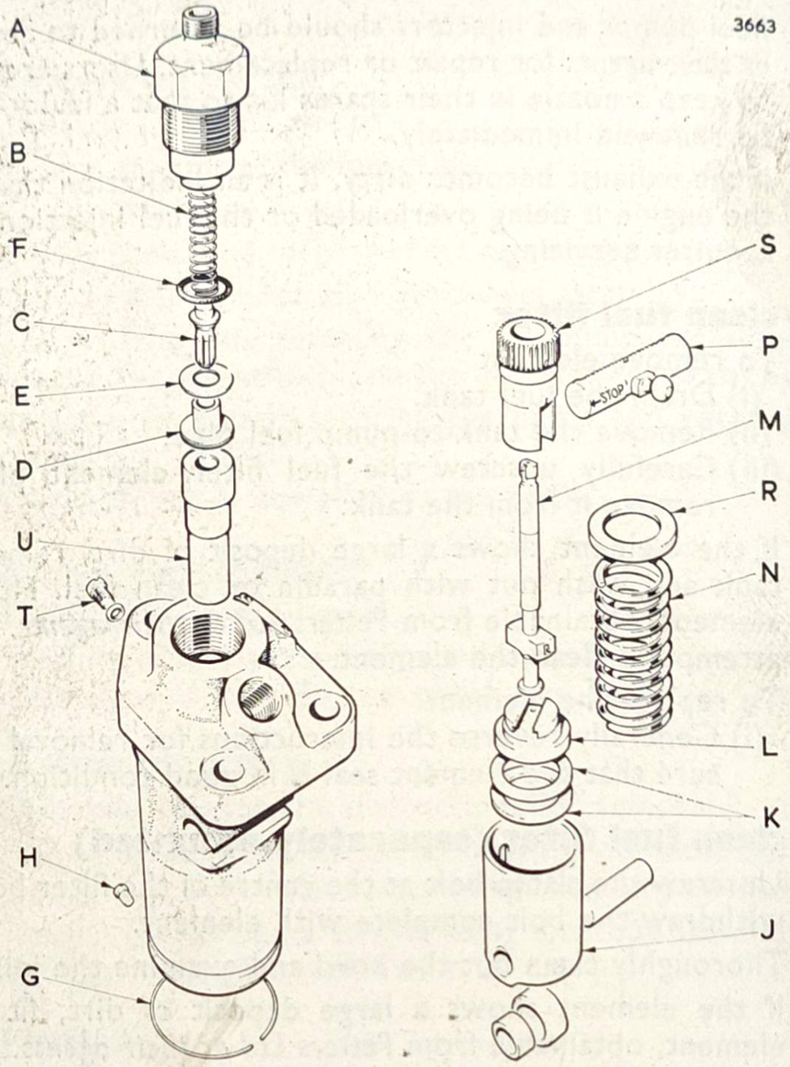


Fig. 12

(*a*) Delivery side
  (i) Thoroughly clean the exterior of the pump.
  (ii) Unscrew the delivery union body (A), lift out the delivery valve spring (B) and the delivery valve (C).
  (iii) Withdraw the delivery valve seat (D), the joint (E) and sealing ring (F).

(*b*) Pump/control side (fixed speed engine only)
  (i) Rotate the circlip (G) in its groove until the dowel (H) is between the ends of the circlip.
  (ii) Press down the tappet and roller assembly against the spring pressure and shake out the dowel (H).
  (iii) Remove the tappet (J) together with the roller and roller pin. Note the number and thickness of the calibrating shims (K) between the tappet and the lower spring plate (L).

(iv) Remove the lower spring plate (L), the plunger (M) and the plunger spring (N). Note the assembly mark on the plunger arm farthest from the rack (P).

(v) Remove the upper spring plate (R) and the pinion (S). Note the assembly marks on one tooth of the pinion (S) and on the rack (P). Note also the relative position of the 'STOP' mark and arrow on the rack before sliding out the rack from the pump body.

(vi) Remove the element locating screw (T) and push out the element (U) through the top of the pump.

70. Fuel injection pump maintenance

(*a*) Each plunger of a pump assembly is mated to one element and must never be used in another.

(*b*) Make sure the delivery valve joint and sealing ring are in good condition and that the valve is seating correctly. Leaking valves cause loss of fuel injection pressure and difficult starting.

(*c*) Make sure the rack is free throughout its travel.

71. To replace fuel injection pump (Fig. 12)

(*a*) Generally reverse the instructions for removal and dismantling.

(*b*) Thoroughly clean all parts in clean fuel and assemble wet.

(*c*) The sealing ring (F) should be fitted over the lower shoulder of the union body (A) before the delivery union body is screwed unto the pump body. Failure to observe this precaution may result in the ring being crushed between the union body and the joint (E). Tighten the delivery union body using a torque spanner set to the figure shown under Technical Data.

(*d*) When assembling the rack (P.) and pinion (S) make sure that the marked tooth of the pinion is opposite the mark on the rack and that the rack is assembled in the pump body so that the 'STOP' mark and arrow will be towards the gear end of the engine when the pump is fitted.

(*e*) Make sure that the element (U) can be moved up and down slightly when the locating screw (T) is tightened.

(*f*) Replace the plunger (M) with the marked locating arm engaged with the marked slot in the pinion (S), i.e., the marked locating arm is towards the locating screw (T).

(*g*) With the element, plunger and pinion correctly assembled, the scroll at the top of the plunger will be adjacent to the fuel port in the side of the element when the rack is in the centre of its travel.

(*h*) Replace the tappet (J) making sure that the correct number and thickness of shims is used.

(*j*) Press down the tappet and roller assembly and fit the dowel (H) to engage with the slot in the tappet. Rotate the dowel to line up its slot with the ends of the circlip (G) and then turn the circlip in its groove until the ends of the circlip are away from the dowel.

(*k*) Make sure that the fuel pump cam is away from the fuel pump housing and turn the engine until the exhaust or inlet valve is open.

(*l*) Make sure that the fuel pump rack ball engages with the fuel pump operating lever fork and that the correct number and thickness of shims is fitted between the pump and the crankcase.

(*m*) IMPORTANT. New fuel injection pumps require special fitting instructions and these are given in the following paragraph.

72. To fit new fuel injection pump (Fig. 13)

(*a*) Fixed speed engines

- (i) Make sure that the fuel pump cam is at the bottom of its stroke. Turn the engine until the exhaust or inlet valve is open.
- (ii) Turn the stop/run lever (B) until the fuel pump operating lever fork end is at the centre of the fuel pump housing.
- (iii) Fit the fuel pump. Make sure that the fuel pump rack ball (S) has engaged with the operating lever fork.

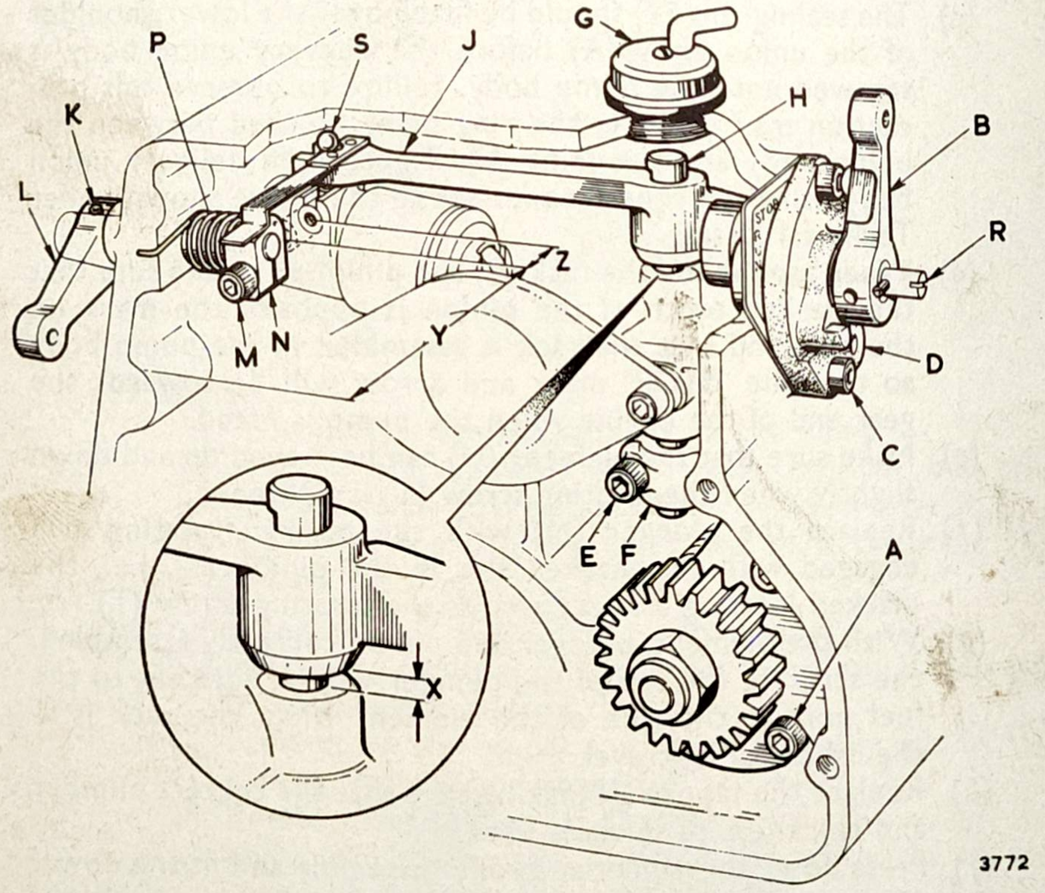


Fig. 13

(*b*) Variable speed engines

(i) to (iii) as for fixed speed engines.

(iv) Loosen the overload stop cam screw (M).

(v) Turn the stop/run lever fully towards the 'STOP' position, and measure the distance (Y) between the end of the fuel pump rack and the gear cover face using a depth gauge.

(vi) On AA1 engines add 0·441in (11·20mm), and AB1 engines 0·500in (12·70mm) (Z) to the depth gauge reading. Reset the fuel pump rack in this position by turning the stop/run lever towards the 'RUN' position.

(vii) Hold the rack in this position and set the overload stop cam (N) to just touch the overload stop on the fuel pump operating lever. With the overload stop cam in this position, tighten the cam screw (M).

(viii) Check that the total movement from the fully forward (stop) position to the overload stop position is 0·441in (11·20mm) on the AA1 engine, and 0·500in (12·70mm) on the AB1 engine.

(*c*) Time the fuel injection pump on all engines.

NOTE: Variable speed engines and some fixed speed engines are fitted with special fuel injection pumps. Quote the type required when ordering new pumps. (See Parts List Plate N).

73. To time fuel injection pump (Fig. 12 & 14)

(*a*) Drain the fuel tank and remove the pump-to-injector fuel pipe.

(*b*) On fixed speed engines running at speeds above 3000 rev/min and on all variable speed engines, move the stop/run lever towards the 'STOP' position, i.e. vertical, and fix it at approximately 10° before the vertical positon. On variable speed engines, move the speed control to the full speed position. DO NOT OPERATE THE OVERLOAD STOP LEVER.

On all fixed speed engines running at 3000 rev/min and below, move the stop/run lever to the 'RUN' position, i.e. horizontal.

(*c*) Unscrew the delivery union body (A) and remove, making sure that the sealing ring (F) is withdrawn also. Lift out the delivery valve (C) and spring (B), placing them in clean fuel. Do not disturb the delivery valve seat (D) or joint washer (E).

(*d*) Position the sealing ring on the delivery union body and replace in the pump body leaving out the delivery valve and spring. Replace the pump-to-injector pipe, connecting the pump end only.

(*e*) With the decompressor lever disengaged, turn the flywheel until it is a quarter of a turn before TDC on the compression stroke.

(*f*) Pour a small quantity of fuel into the tank and bleed the fuel filter, if fitted. A small stream of fuel should now flow from the pump-to-injector pipe.

(*g*) Engage the decompressor lever and turn the flywheel slowly by hand in a clockwise direction until the flow from the pipe stops. Find by repeated trial the EXACT flywheel position at which this happens. This position is known as the spill point.

(*h*) Read off the angle through the timing hole at the mark on the bellhousing. Check this with the figure shown under Technical Data. If the angle is too large, add shims between the pump and crankcase until the correct timing is obtained. If too small, remove shims.

(*j*) When the correct timing is obtained, reassemble the fuel injection equipment including the fuel delivery valve and spring. Ensure that the union body sealing ring is not damaged and is located on the union body shoulder before replacing in the pump.

(*k*) Tighten the delivery union body using a torque spanner set to the figure shown under Technical Data.

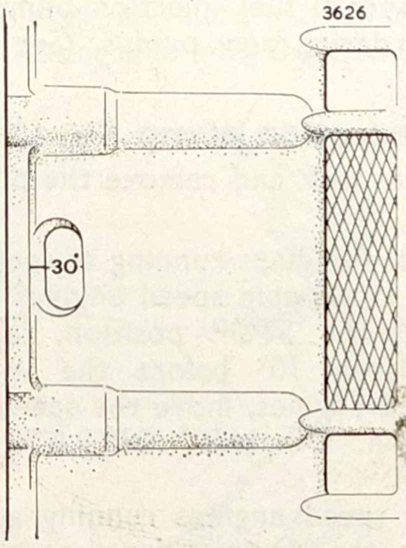


Fig. 14

74. To remove and test fuel injector

(*a*) Remove the cowling.

(*b*) Disconnect the fuel feed and leak-off pipes from the injector.

(*c*) Remove the injector flange nuts and carefully lever out the injector.

(*d*) Reconnect the injector to the pump-to-injector pipe in such a way that the nozzle points away from the engine.

(*e*) With the speed control lever, if fitted, in the full speed position, and with the stop/run lever in the 'RUN' position turn the engine over slowly. The fuel should squirt out suddenly in a fine mist spray which should stop as suddenly. If the nozzle fails to spray, or gives a solid squirt of fuel, or dribbles after the spray has stopped, fit a new nozzle.

(*f*) When testing, BE CAREFUL to see that the spray is not directed at any exposed part of the body. The force behind the spray will cause it to penetrate the skin.

75. Fuel injector maintenance (Fig. 15)

An injector servicing kit consisting of brass wire brush, nozzle scraper and spray hole cleaner is obtainable from *Petters Ltd or their agents.*

(*a*) Thoroughly clean the exterior of the injector.

(*b*) Remove the nozzle holder cap nut (A) and the locknut (B).

(*c*) Remove the spring adjusting screw (C) and remove the spring pad (D), the spring (E) and the spring pressure rod (F).

(*d*) Remove the nozzle nut (G) and the nozzle assembly (H). Each needle of a nozzle assembly is mated to one nozzle body and must never be used in another.

(*e*) To ensure a thorough cleaning of all parts they should be left in a bath of clean fuel. After this treatment, any remaining carbon can be scraped off with a soft brass wire brush or piece of clean wood or brass.

(*f*) The nozzle holder and nozzle joint faces must be clean with a mirror-like appearance. The nozzle and nozzle nut clamping shoulders must be clean.

(*g*) The nozzle body fuel holes (J) should be cleaned by pushing a wire or twist drill (K) down into the fuel chamber (L), being careful not to scratch the joint face.

(*h*) Insert a nozzle scraper (M) down into the fuel chamber, press sideways and rotate to remove carbon, etc.

(*j*) Soft carbon can be removed from the spray hole with a spray hole cleaner (N).

(*k*) Wash the nozzle body and needle in clean fuel and assemble wet.

(*l*) To fit a nozzle assembly to the nozzle holder body, hold it hard against the pressure face and tighten the nozzle nut.

(*m*) To complete the assembly of the injector, grease the spring assembly and replace it, together with the adjuster, locknut and cap nut.

(*n*) Reset the fuel injector release pressure to the figure shown under Technical Data. A test pump for this purpose can be obtained from *Petters Ltd or their agents.* To adjust the release pressure, loosen the locknut (B) and screw in the adjusting screw (C) to increase the pressure or out to decrease it. Tighten the locknut.

(*p*) Injectors not required for immediate use should have pipe connections sealed against the admission of dirt, etc.

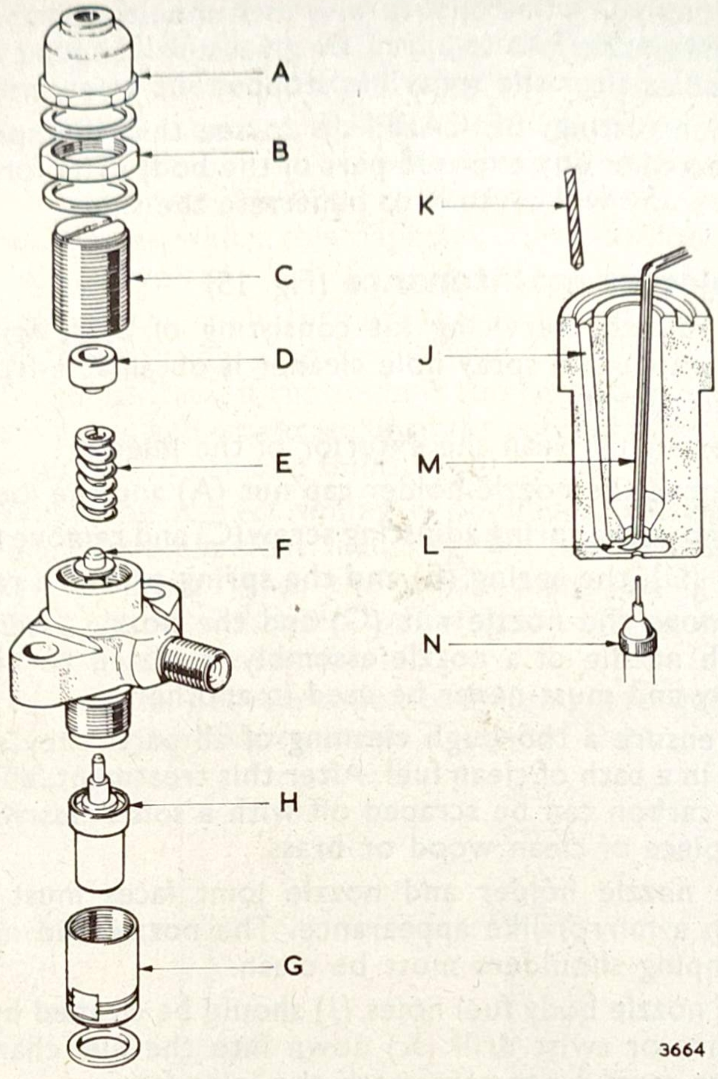


Fig. 15

76. To replace fuel injector

(*a*) Examine the joint washer and renew if necessary.

(*b*) It is MOST IMPORTANT that the pump-to-injector pipe is correctly fitted or the pipe and injector may be damaged. Proceed as follows:

- (i) Loosely fit the injector flange nuts.
- (ii) Fit the pipe and tighten the union nuts finger tight, then give them a third of a turn with a spanner.
- (iii) Tighten the injector stud nuts evenly, using a torque spanner set to the figure shown under Technical Data.

(*c*) Reconnect the leak-off pipe.

77. To adjust speed control (Figs 16 & 17)

The centrifugal forces on the governor balls are transmitted to the fuel pump rack. These forces, which vary with the speed of the engine, are balanced by an adjustable speeder spring (A). This adjustment allows a set of range speed. To adjust the speed outside this range a different fuel pump and springs may be required and these are obtainable from *Petters Ltd or their agents.* The speed is set by *Petters Ltd* and should not require further adjustment. However, if the setting is disturbed, adjustments are carried out as follows:

(*a*) Fixed speed

(i) Loosen the locknut (C) on the dipstick side of the engine and screw in the adjuster (B) to increase the speed or out to decrease it. Tighten the locknut. The speed should be set at 4% above the rated speed as shown on the engine nameplate, when running without load.

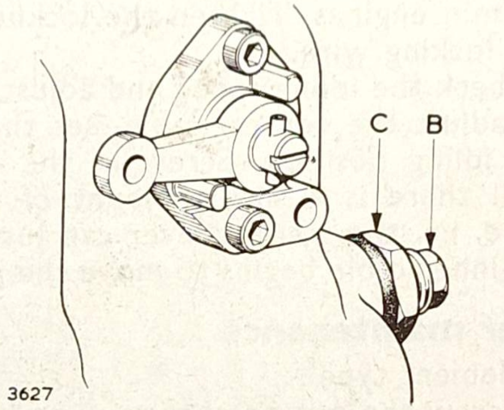


Fig. 16

(*b*) Variable and two-speed control

(i) Set the speed control in the idling position, i.e. with plunger (F) firmly in direction of arrow.

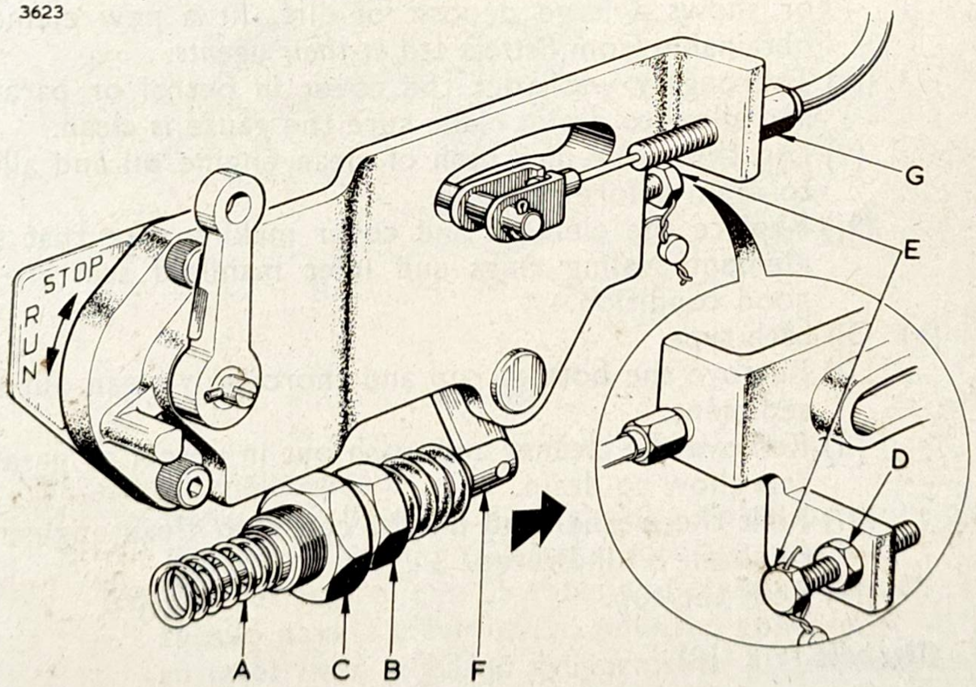


Fig. 17

(ii) Loosen the locknut (C) and adjust the idling speed to approximately 1000 rev/min by screwing in the adjuster (B) to increase the speed or out to decrease it. Tighten the locknut.

(iii) Set the speed control in the full speed position or 'RUN' position on a two-speed control.

(iv) Loosen the locknut (D) and adjust to full speed or speed required by screwing the adjusting screw (E) out to increase the speed or in to decrease it. The speed should be set at 8% above the rated speed as shown on the engine nameplate, when running without load, i.e. 3240 for 3000 rev/min engines and 3888 for 3600 rev/min engines. Tighten the locknut and fit new seal and locking wire.

(v) Recheck the idling speed and adjust if not correct.

(vi) To adjust the control cable, set the speed control in the idling position. Screw in the cable adjuster (G) until there is a small amount of slack in the inner cable, i.e. the control lever can just be moved before the inner cable begins to move the plunger (F).

78. Air cleaner maintenance

(*a*) Paper element type

(i) Unscrew the nut on the cover and remove the cover.

(ii) Remove the element. The element may be cleaned by blowing compressed air from the inside to the outside. Do not attempt to clean the element by any other means.

(iii) A strong light directed into the inside of an element and viewed from the outside will reveal any damage to the paper corrugations. If the element is damaged or shows a large deposit of dirt, fit a new element obtainable from *Petters Ltd or their agents.*

(iv) Thoroughly wash out the cover in petrol or paraffin and allow to drain. Make sure the gauze is clean.

(v) Dip the cover in a bath of clean engine oil and allow to drain before refitting.

(vi) Replace the element and cover making sure that the element sealing rings aud inlet manifold seal are in good condition.

(*b*) Oil bath type

(i) Remove the bottom cup and thoroughly clean out the sediment.

(ii) Remove the cleaner and wash out in petrol or paraffin and allow to drain.

(iii) Refit the cleaner and fill the cup with clean engine oil to the level indicated.

(iv) Refit the cup.

79. Clutch (Fig. 18)

(*a*) To remove

(i) Remove the screws (A) securing the clutch housing (B) to the crankcase and withdraw the housing complete with the operating lever and shaft.

(ii) Slacken each setscrew (C) securing the clutch to the flywheel half a turn at a time working diagonally across the clutch until all the clutch spring pressure is released. Remove the setscrews.

(iii) Remove the clutch (D) and clutch plate (E) from the flywheel. The clutch is dowelled to the flywheel.

(iv) The clutch should not be dismantled unless special tools are available for assembly and balancing the clutch.

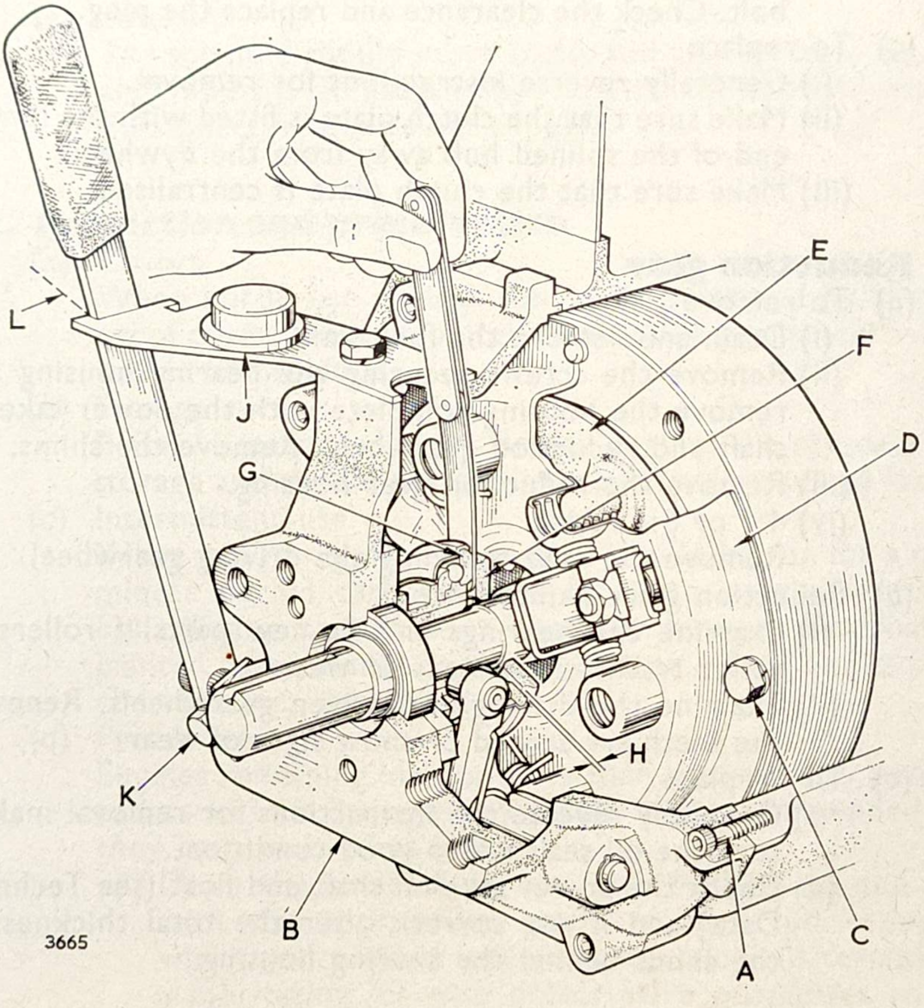


Fig. 18

(*b*) Clutch maintenance

(i) Parts most likely to wear are the clutch pressure plate (F), thrust bearing (G) and the clutch linings.

(ii) The surfaces of the flywheel and clutch pressure plate should have a clean, even, polished appearance. If the surfaces have a glazed or varnished appearance make sure that oil is not penetrating to the clutch housing from the engine.

(iii) If the clutch plate linings or splines are worn fit a new clutch plate. Do not attempt to fit new linings.

(iv) Check the clearance (H) between the clutch pressure plate (F) and the thrust bearing (G). The clearance should be 0·10/0·15in (2·5/2·8mm) and may be checked be removing the plug (J) and inserting a feeler gauge between the pressure plate and the thrust bearing. To adjust the clearance, loosen the operating lever pinch bolt (K). With the lever in the engaged position (L) turn the yoke shaft against the spring pressure until the feeler gauge is gripped between the thrust bearing and pressure plate and then tighten the pinch bolt. Check the clearance and replace the plug.

(*c*) To replace

(i) Generally reverse instructions for removal.

(ii) Make sure that the clutch plate is fitted with the longer end of the splined hub away from the flywheel.

(iii) Make sure that the clutch plate is centralised.

80. Reduction gear

(*a*) To remove

(i) Drain and remove the fuel tank.

(ii) Remove the screws securing the bearing housing and remove the housing complete with the power take-off shaft and reduction gearwheel. Remove the shims.

(iii) Remove the reduction gear housing.

(iv) 4:1 or 6:1 ratios

Remove the nuts retaining the driving gearwheel.

(*b*) Reduction gear maintenance

(i) Examine the bearings and fit new parts if rollers or roller tracks show signs of wear.

(ii) Examine the driving and driven gearwheels. Renew if the teeth are scored or show signs of wear.

(*c*) To replace

(i) Generally reverse the instructions for removal making sure the oil seals are in good condition.

(ii) Check the power take-off shaft end float (see Technical Data) and if not correct, alter the total thickness of the shims behind the bearing housing.

81. Electric starting equipment (negative earth)

This consists of a starter motor engaging with a gear ring on the flywheel and a switch. Energising the solenoid on the starter motor engages a motor pinion with the flywheel gear ring. The pinion remains engaged as long as the solenoid is actuated, but a free-wheel prevents overspeeding the motor when the engine fires.

Starter motor

(*a*) Mounting

Make sure the motor is securely mounted on the engine.

(*b*) Lubrication

Bearings are lubricated on assembly and require no attention between overhaul periods.

(c) Terminals

Main terminals and all circuit connections must be clean and tight. Terminal shrouds should be in position.

(*d*) Brush gear

Remove the cover and inspect the brushes and commutator. Brushes should be free in their slides. Springs should seat squarely on the brushes. See that the insulation is in good condition. The brushes and commutator should be free from dust and grease and contact surfaces clean, smooth and uniform in colour.

(e) Solenoid

The solenoid should move freely and contact faces be clean and unburnt. Do not attempt to clean the solenoid without disconnecting the power supply.

82. Protection and preservation

(*a*) Covers

When not in use engines should be protected by a waterproof cover. Under tropical conditions a permanent awning should be provided.

(*b*) Storage

Before dispatch from the factory engines are preserved for storage and should not be disturbed until required for use.

(*c*) Intermittent use

When not in regular use engines should be run for a thirty minute period each week to lubricate internal parts and boil off any condensation that has formed. External unpainted parts should be wiped with an oil rag and external controls, etc., lubricated.

(*d*) Preservation

Engines remaining idle for more than a month may corrode, and as serious damage may result it is recommended that they be preserved as follows:

(i) Drain the sump, flush out with flushing oil and refill with the appropriate grade of *Shell* lubricating oil which will provide internal protection. (Alternatively, a lubricating oil with preservative properties will be recommended by a local oil distributor.)

(ii) Drain the fuel tank and filter and refill with approximately I pint (0·57 litres) of *Shell Fusus* oil or *Calibration Fluid C*. Bleed and prime the fuel system and run the engine on light load for five minutes. The fuel system is now adequately protected.

(iii) The air inlet and exhaust manifolds should be sealed against the ingress of moisture.

(iv) Protected engines require no attention before use other than removing the sealing covers and adding fuel.

g Parts List

When ordering parts, state the engine type and serial number, the reference number of the part and the quantity required.

Common detail parts are separately listed in numerical order at the end of the parts list and these may generally be obtained locally.

Requests for parts and service should be directed to:

Overseas

The appointed *Petter agent or dealer* in the territory.

United Kingdom

Petters Ltd Service Division or *Service Depot* at the addresses shown at the front of this handbook.

* *Denotes that the part is not illustrated.*

Important

When purchasing parts or giving instructions for repairs, customers should, in their own interest, always specify:

Genuine Petter Parts

Parts that have not been supplied by the *Petter* organisation cannot be relied upon for correct material, dimensions or finish. *Petters* cannot therefore, be responsible for any damage arising from the use of such parts and the guarantee will be invalidated.

In your own interest, therefore, specify:

Genuine Petter Parts

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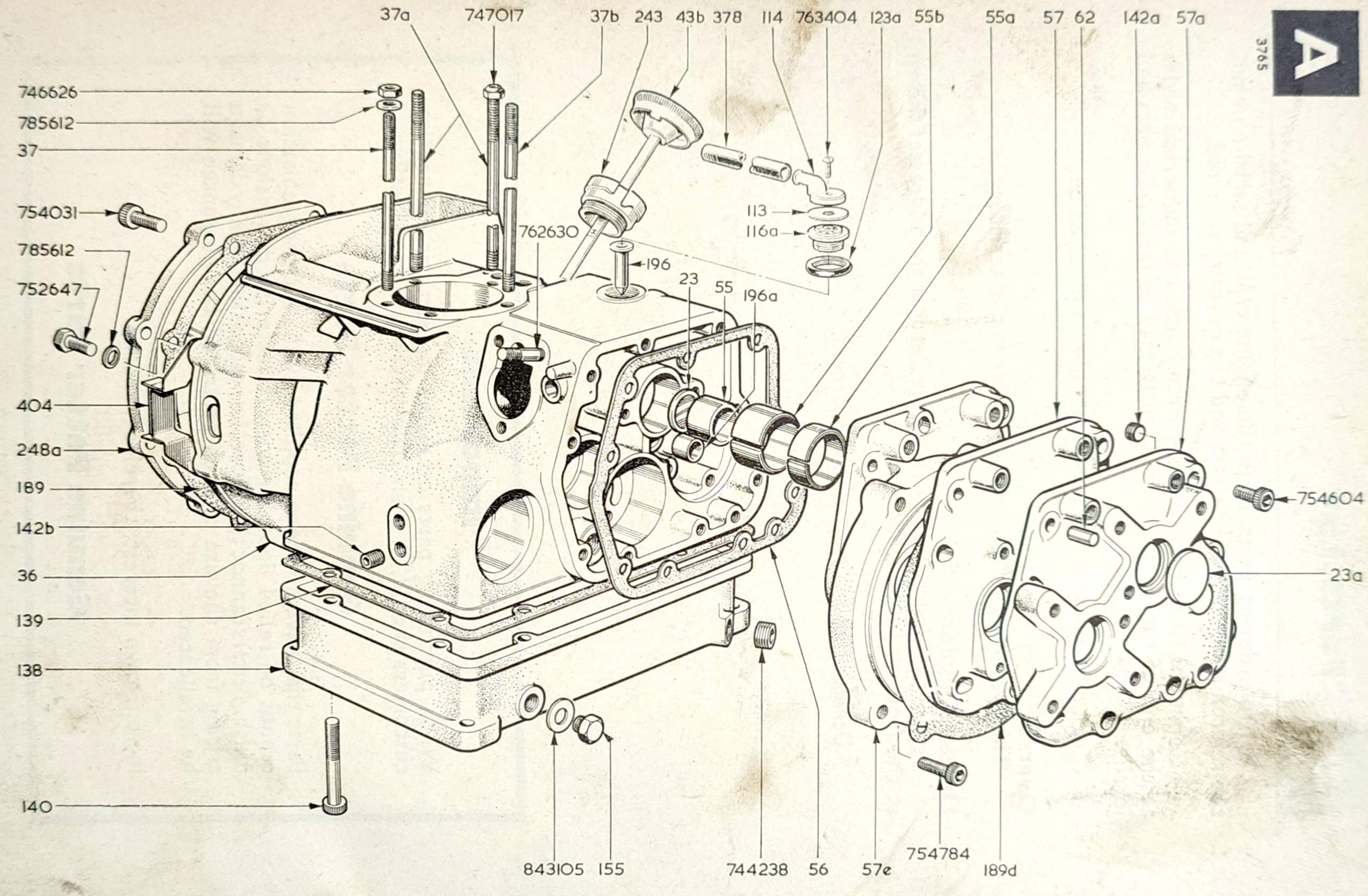
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PLATE A

CRANKCASE

Ref. No.	Description	AA1	AB1
AAA23	Plug—Camshaft Bore (Flywheel end)	1	1
AAA23a	Plug—Gear Cover	1	1
ABA36	Crankcase, complete with Camshaft Bushes, Fuel Pump Lever Operating Shaft Bush, Governor Shaft Bush and Gear End Main Bearing	1	1
***ACA36**	Crankcase, complete with Camshaft Bushes, Fuel Pump Lever Operating Shaft Bush, Governor Shaft Bush and Gear End Main Bearing (Electric Starting)	1	1
AAA37	Stud—Cylinder Head (Short)	2	2
***ACA37**	Stud—Cylinder Head (Short) (Electric Starting)	2	2
AAA37a	Stud—Cylinder Head (Long)	2	2
AAA37a	Stud—Cylinder Head (6½ pint and 2 gal Fuel Tank)	1	1
***ACA37a**	Stud—Cylinder Head (Long) (for use with engines having a separately mounted Fuel Tank)	—	1
***ACA37a**	Stud—Cylinder Head (Long) (Electric Starting)	2	2
ACA37b	Stud—Cylinder Head (9 pint Fuel Tank and Electric starting	1	1
AAA43b	Dipstick, complete with Oil Filler Cap	1	1
AAA55	Bearing—Camshaft (Flywheel end)	1	1
AAA55a	Bearing—Camshaft (Gear end)	1	1
AAA55b	Bearing—Camshaft (Intermediate)	1	1
AAA56	Joint—Gear Cover (Supplied only in Sets of Joints)	1	1
AAA57	Cover—Gear	1	1
AAA57a	Cover—Gear (4:1 Hand Starting, Raised Hand Starting and Electric Starting)	1	1
ABA57e	Cover—Gear (Flange Mounting)	1	1
AAA62	Dowel—Gear Cover	2	2
ACA113	Valve—Breather	1	1
ACA114	Cover—Breather	1	1
ACA116a	Housing—Breather	1	1
ACA123a	Seal—Breather	1	1
AAA138	Sump	1	1
AAA139	Joint—Sump (Supplied only in Sets of Joints)	1	1
AAA140	Screw—Sump	8	8
AAA142a	Plug—Gear Cover (4:1 Hand Starting)	3	3
AAA142a	Plug—Gear Cover (Raised Hand Starting)	2	2
AAA142b	Plug—Crankcase	1	1
AAA155	Plug—Sump Drain	2	2
BAA184	Cover—Fuel Feed Pump (Electric Starting)	1	1
BAA187	Joint—Fuel Feed Pump Cover	1	1
AAA189	Shim—Bellhousing Adaptor (Flange Mounting)	As reqd.	
ABA189d	Shim—Gear Cover (Flange Mounting)	As reqd.	
AAA196	Bush—Fuel Pump Lever Operating Shaft	1	1
AAA196a	Bush—Governor Shaft	1	1
AAA243	Collar—Oil Filler	1	1
ABA248a	Adaptor—Bellhousing (Flange Mounting)	1	1
ACA378	Pipe—Breather	1	1
AAA404	Bracket—Pulley Guard Catchplate (Rope Starting) (Flywheel end)	1	1

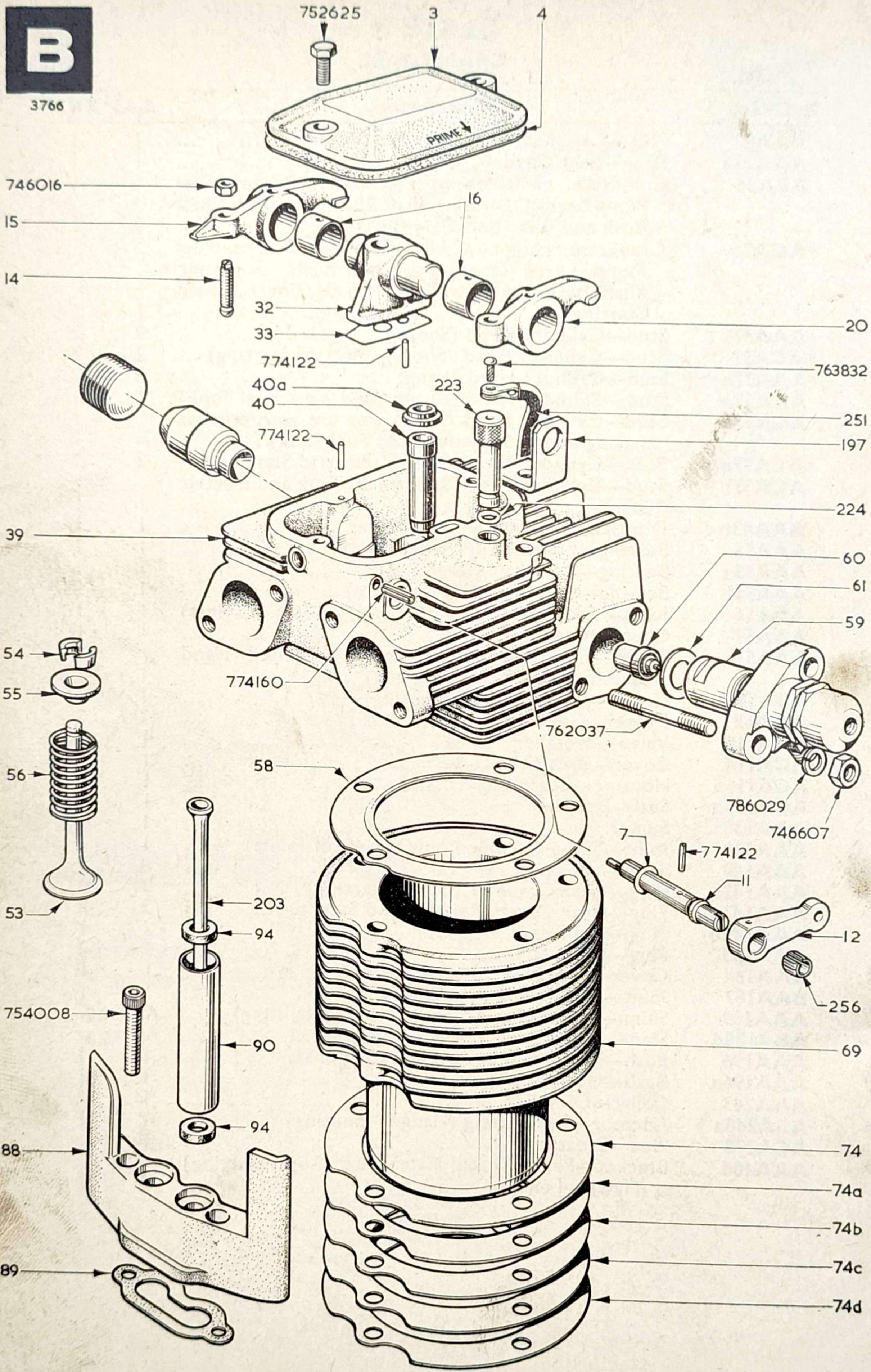
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PLATE B

CYLINDER AND CYLINDER HEAD

Ref. No.	Description	AA1	AB1
AAB3	Cover—Rocker Box	1	1
AAB4	Joint—Rocker Box Cover (Supplied only in Sets of Joints)	1	1
AAB7	Oil Seal—Decompressor Shaft	1	1
AAB11	Shaft—Decompressor	1	1
AAB12	Lever—Decompressor	1	1
AAB14	Screw—Valve Rocker Adjusting	2	2
AAB15	Rocker—Exhaust Valve	1	1
AAB16	Bush—Valve Rocker	2	2
AAB20	Rocker—Inlet Valve	1	1
ABB32	Support—Rocker	1	1
AAB33	Joint—Rocker Support	1	1
ABB39	Cylinder Head, complete with Valve Guides, Valves, Valve Springs, Valve Inserts, Air Cell and Plug	—	1
*__AAB39a__	Cylinder Head, complete with Valve Guides, Valves, Valve Springs, Valve Inserts, Air Cell and Plug	1	—
ABB40	Guide—Valve	2	2
ABB40a	Spring Plate—Valve Guide	2	2
ABB53	Valve	2	2
ABB54	Collet—Valve	2 prs.	2 prs.
ABB55	Cup—Valve	2	2
ABB56	Spring—Valve	2	2
*__AAB58__	Gasket—Cylinder Head (Supplied only in Sets of Joints)	1	—
ABB58	Gasket—Cylinder Head (Supplied only in Sets of Joints)	—	1
AAB59	Holder—Fuel Injector Nozzle	1	1
AAB60	Nozzle—Fuel Injector	1	1
AAB61	Joint Washer—Fuel Injector Nozzle (Supplied only with Fuel Injector Nozzle or in Sets of Joints)	1	1
ABB69	Cylinder	—	1
*__AAB69a__	Cylinder	1	—
ABB74	Shim—Cylinder (0·003″)	As reqd.	
ABB74a	Shim—Cylinder (0·005″)	As reqd.	
ABB74b	Shim—Cylinder (0·010″)	As reqd.	
ABB74c	Shim—Cylinder (0·015″)	As reqd.	
ABB74d	Shim—Cylinder (0·020″)	As reqd.	
ACB88	Base—Push Rod Tube	1	1
AAB89	Joint—Push Rod Tube Base (Supplied only in Sets of Joints)	1	1
ABB90	Tube—Push Rod	2	2
ABB94	Seal—Push Rod Tube	4	4
AAB197	Bracket—Lifting	1	1
AAB203	Push Rod—Valve	2	2
AAB223	Plunger—Priming	1	1
AAB224	Oil Seal—Priming Plunger	1	1
AAB251	Chain—Priming Plunger	1	1
AAB256	Bush—Decompressor Shaft	1	1

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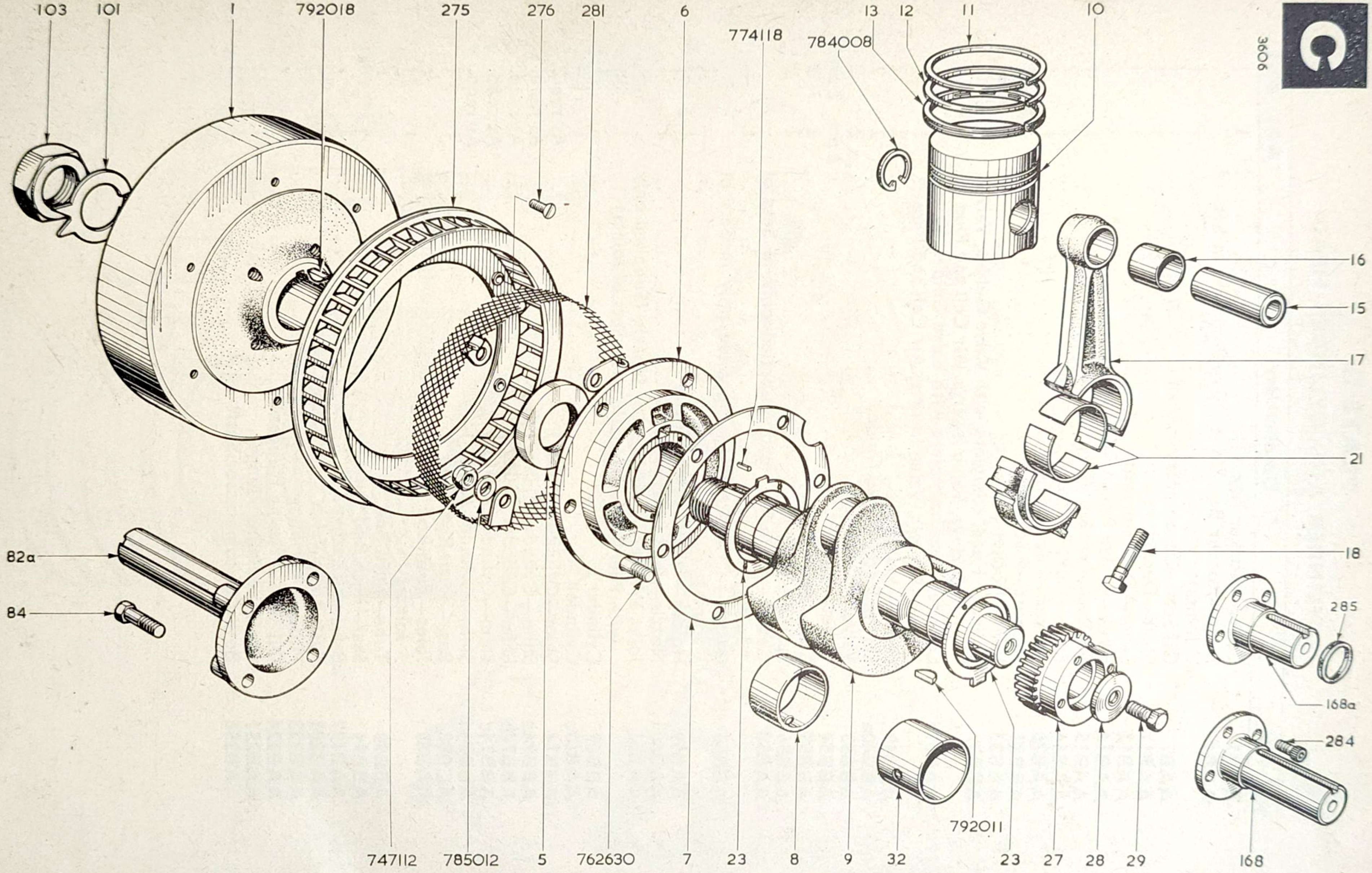
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PLATE C
CRANKSHAFT AND PISTON

Ref. No.	Description		AA1	AB1
***AAC1**	Flywheel		1	—
ABC1	Flywheel		—	1
***AAC1a**	Flywheel (Clutch)		1	—
***ABC1a**	Flywheel (Clutch)		—	1
***WAC1a**	Flywheel and Gear Ring Assembly (Electric Starting)		1	1
AAC5	Oil Seal		1	1
AAC6	Housing—Main Bearing (Flywheel end)		1	1
AAC7	Joint—Main Bearing Housing (Supplied only in Sets of Joints)		1	1
ACC8	Bearing—Main (Flywheel end) (Standard)		1	1
***ACC8−10**	Bearing—Main (Flywheel end) (0·010″ Undersize)		1	1
***ACC8−20**	Bearing—Main (Flywheel end) (0·020″ Undersize)		1	1
AAC9	Crankshaft		1	1
***AAC10**	Piston Assembly, complete with Rings, Pin and Circlips (Standard)		1	—
***AAC10+20**	Piston Assembly, complete with Rings, Pin and Circlips (0·020″ Oversize)		1	—
***AAC10+30**	Piston Assembly, complete with Rings, Pin and Circlips (0·030″ Oversize)		1	—
***AAC10+40**	Piston Assembly, complete with Rings, Pin and Circlips (0·040″ Oversize)		1	—
ABC10	Piston Assembly, complete with Rings, Pin and Circlips (Standard)		—	1
***ABC10+20**	Piston Assembly, complete with Rings, Pin and Circlips (0·020″ Oversize)		—	1
***ABC10+30**	Piston Assembly, complete with Rings, Pin and Circlips (0·030″ Oversize)		—	1
***ABC10+40**	Piston Assembly, complete with Rings, Pin and Circlips (0·040″ Oversize)		—	1
***AAC11**	Ring—Compression (Chromium Plated) (Standard)	Only supplied in Standard or Oversize Sets	1	—
***AAC11+20**	Ring—Compression (Chromium Plated) (0·020″ Oversize)		1	—
***AAC11−30**	Ring—Compression (Chromium Plated) (0·030″ Oversize)		1	—
***AAC11+40**	Ring—Compression (Chromium Plated) (0·040″ Oversize)		1	—
ABC11	Ring—Compression (Chromium Plated) (Standard)		—	1
***ABC11+20**	Ring—Compression (Chromium Plated) (0·020″ Oversize)		—	1
***ABC11+30**	Ring—Compression (Chromium Plated) (0·030″ Oversize)		—	1
***ABC11+40**	Ring—Compression (Chromium Plated) (0·040″ Oversize)		—	1
***AAC12**	Ring—Compression (Plain) (Standard)		1	—
***AAC12+20**	Ring—Compression (Plain) (0·020″ Oversize)		1	—
***AAC12+30**	Ring—Compression (Plain) (0·030″ Oversize)		1	—
***AAC12+40**	Ring—Compression (Plain) (0·040″ Oversize)		1	—
ABC12	Ring—(Compression Plain) (Standard)		—	1
***ABC12+20**	Ring—Compression (Plain) (0·020″ Oversize)		—	1
***ABC12+30**	Ring—Compression (Plain) (0·030″ Oversize)		—	1
***ABC12+40**	Ring—Compression (Plain) (0·040″ Oversize)		—	1

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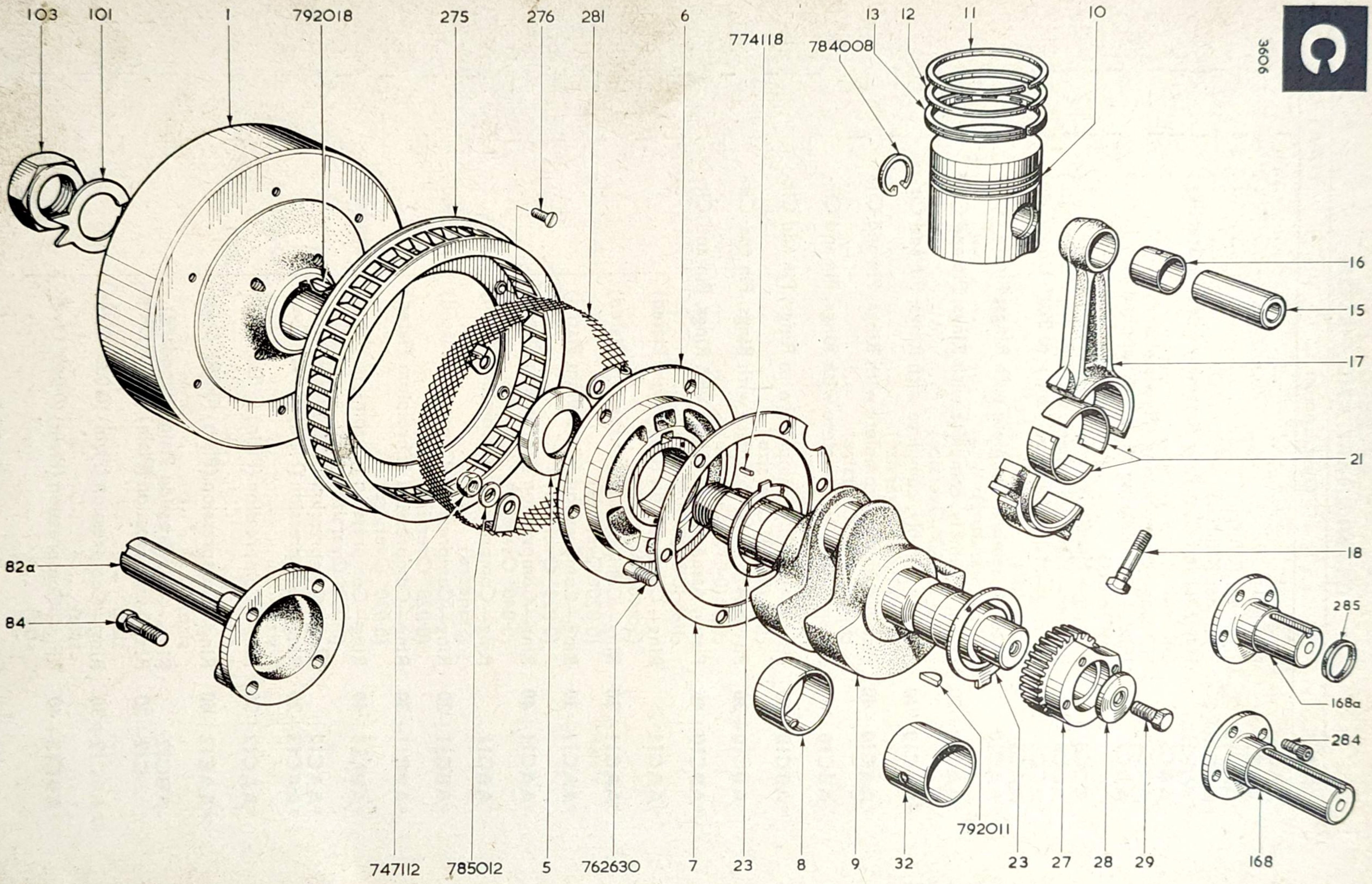
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Ref. No.	Description		AAI	ABI
*AAC13	Ring—Scraper (Standard)	Only supplied in Standard or Oversize Sets	1	—
*AAC13+20	Ring—Scraper (0·020″ Oversize)		1	—
*AAC13+30	Ring—Scraper (0·030″ Oversize)		1	—
*AAC13+40	Ring—Scraper (0·040″ Oversize)		1	—
ABC13	Ring—Scraper (Standard)		—	1
*ABC13+20	Ring—Scraper (0·020″ Oversize)		—	1
*ABC13+30	Ring—Scraper (0·030″ Oversize)		—	1
*ABC13+40	Ring—Scraper (0·040″ Oversize)		—	1
*AAC15	Gudgeon Pin		1	—
ABC15	Gudgeon Pin		—	1
AAC16	Bush—Small End		1	1
AAC17	Connecting Rod Assembly, complete with Small End Bush, Standard Large End Bearing and Bolts		1	1
AAC18	Bolt—Large End		2	2
AAC21	Bearing—Large End (Standard)		1 pr.	1 pr.
*AAC21-10	Bearing—Large End (0·010″ Undersize)		1 pr.	1 pr.
*AAC21-20	Bearing—Large End (0·020″ Undersize)		1 pr.	1 pr.
AAC23	Washer—Crankshaft Thrust		2	2
AAC27	Gearwheel—Crankshaft		1	1
AAC28	Plate—Gearwheel Retaining		1	1
AAC29	Screw—Gearwheel Retaining		1	1
AAC32	Bearing—Main (Gear end) (Standard)		1	1
*AAC32-10	Bearing—Main (Gear end) (0·010″ Undersize)		1	1
*AAC32-20	Bearing—Main (Gear end) (0·020″ Undersize)		1	1
AAC82a	Shaft—Flywheel Extension		1	1
AAC82a	Shaft—Flywheel Extension (Electric Starting—Flywheel end)		1	1
*AAC82b	Shaft—Crankshaft Extension (Electric Starting—Gear end)		1	1
AAC84	Bolt—Flywheel Extension Shaft		4	4
AAC101	Tabwasher—Flywheel		1	1
AAC103	Nut—Flywheel		1	1
AAC168	Shaft—Crankshaft Extension		1	1
*AAC168a	Shaft—Crankshaft Extension (Rope Starting—Gear end)		1	—
ABC168a	Shaft—Crankshaft Extension (Rope Starting—Gear end)		—	1
*ABC168a	Shaft—Crankshaft Extension (Rope Starting—Gear end) (9 pint Fuel Tank)		1	—
AAC275	Fan—Flywheel		1	1
AAC276	Screw—Flywheel Fan		6	6
AAC281	Guard—Flywheel		1	1
*ACC281	Guard—Flywheel (Electric Starting)		1	1
AAC284	Screw—Crankshaft Extension Shaft		4	4
AAC285 A	Oil Seal—Crankshaft Extension Shaft		1	1

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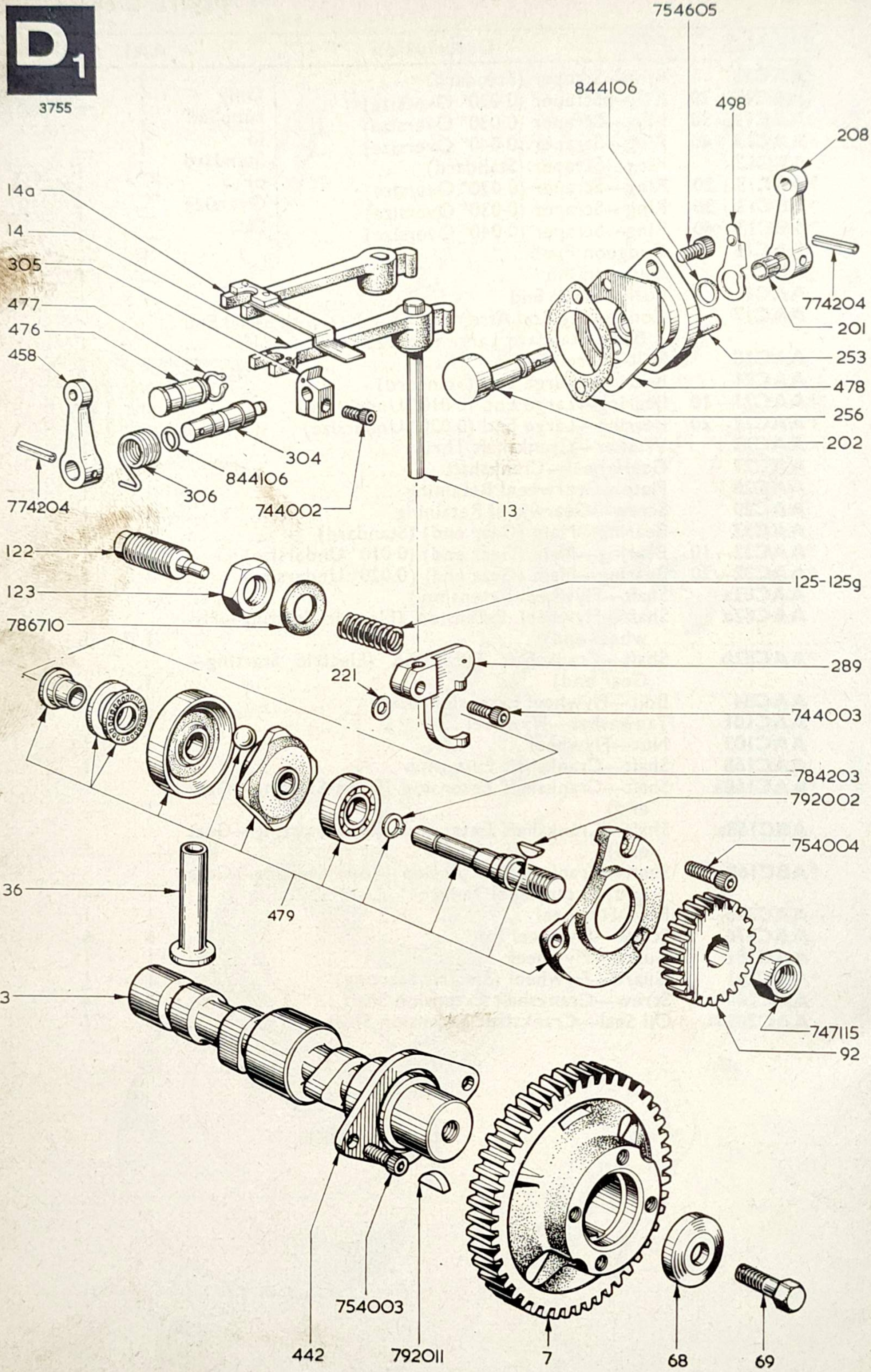

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PLATE D1

CAMSHAFT GOVERNOR AND LINKAGE, OVERLOAD STOP, STOP/RUN AND FIXED SPEED CONTROLS

Ref. No.	Description	AA1	AB1
*AAD3	Camshaft	1	—
ABD3	Camshaft	—	1
*ACD3	Camshaft (Electric Starting)	—	1
AAD7	Gearwheel—Camshaft	1	1
AAD13	Shaft—Lever Operating	1	1
AAD14	Lever—Fuel Pump Operating	1	1
AAD14a	Lever—Fuel Pump Operating (Variable Speed)	1	1
AAD36	Tappet—Valve	2	2
AAD68	Plate—Gearwheel Retaining	1	1
AAD69	Screw—Gearwheel Retaining	1	1
AAD92	Gearwheel—Governor	1	1
AAD122	Adjuster—Speeder Spring	1	1
AAD123	Locknut—Speeder Spring Adjuster	1	1
AAD125-g	Speeder Spring (for details see separate list)	1	1
AAD201	Bush—Stop/Run Lever	1	1
AAD202	Spindle—Stop/Run Lever	1	1
AAD208	Lever—Stop/Run	1	1
AAD221	Spacer—Governor Bracket	1	1
AAD253	Cover—Stop/Run Lever Assembly	1	1
AAD256	Joint—Cover	1	1
AAD289	Bracket—Governor	1	1
AAD304	Spindle—Overload Stop	1	1
AAD305	Cam—Overload Stop	1	1
AAD306	Spring—Overload Stop Return	1	1
AAD442	Plate—Camshaft Thrust	1	1
AAD458	Lever—Overload Stop	1	1
AAD476	Spindle—Overload Stop Blanking	1	1
AAD477	Circlip—Overload Stop Blanking Spindle	1	1
AAD478	Plate—Stop/Run	1	1
AAD479	Governor Assembly	1	1
AAD498	Spring—Stop/Run Lever	1	1

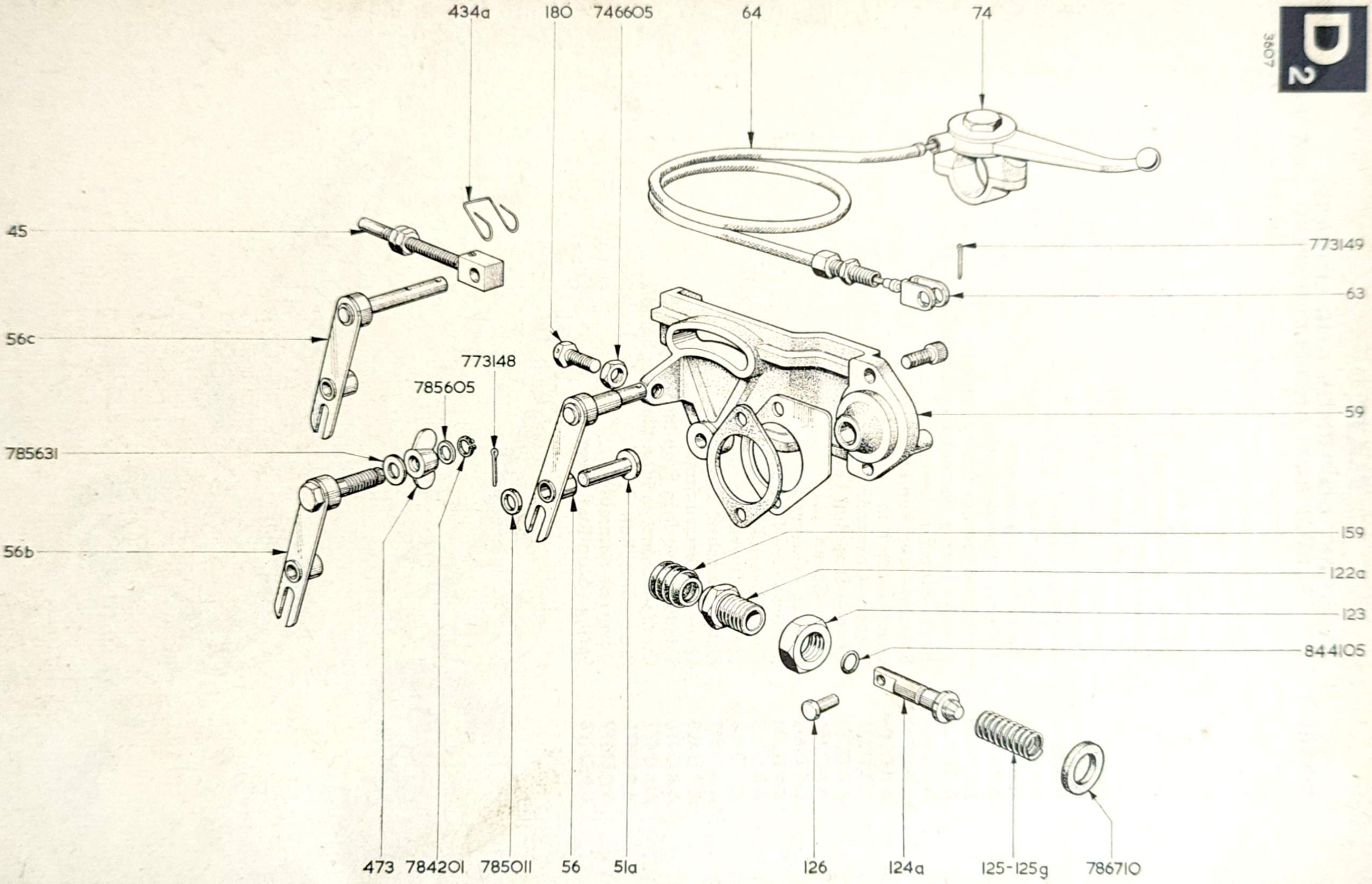
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PLATE D2

VARIABLE AND TWO-SPEED CONTROLS

Ref. No.	Description	AA1	AB1
AAD45	Link Assembly—Two-Speed Control	1	1
AAD51a	Pin—Control Lever	1	1
AAD56	Lever—Contol (Cable Control)	1	1
AAD56b	Lever—Control (Hand Control)	1	1
AAD56c	Lever—Control (Two-Speed Control)	1	1
AAD59	Bracket—Speed Control	1	1
JD63	Shackle—Control Cable	1	1
AAD64	Cable—Control	1	1
TD74	Lever—Cable Control	1	1
AAD122a	Adjuster—Speeder Spring	1	1
AAD123	Locknut—Speeder Spring Adjuster	1	1
AAD124a	Plunger—Speeder Spring	1	1
AAD125-g	Spring—Speeder (for details see separate list)	1	1
AAD126	Pin—Speeder Spring Plunger	1	1
AAD159	Bellows—Speeder Spring Plunger	1	1
WAD180	Screw—Speed Adjusting	1	1
***JD298**	Wire—Speed Adjusting Screw Locking	As reqd.	
AAD434a	Spring—Two-Speed Control Link Assembly	1	1
***AAD471**	Seal—Locking Wire	1	1
AAD473	Wingnut—Control Lever (Hand Control)	1	1

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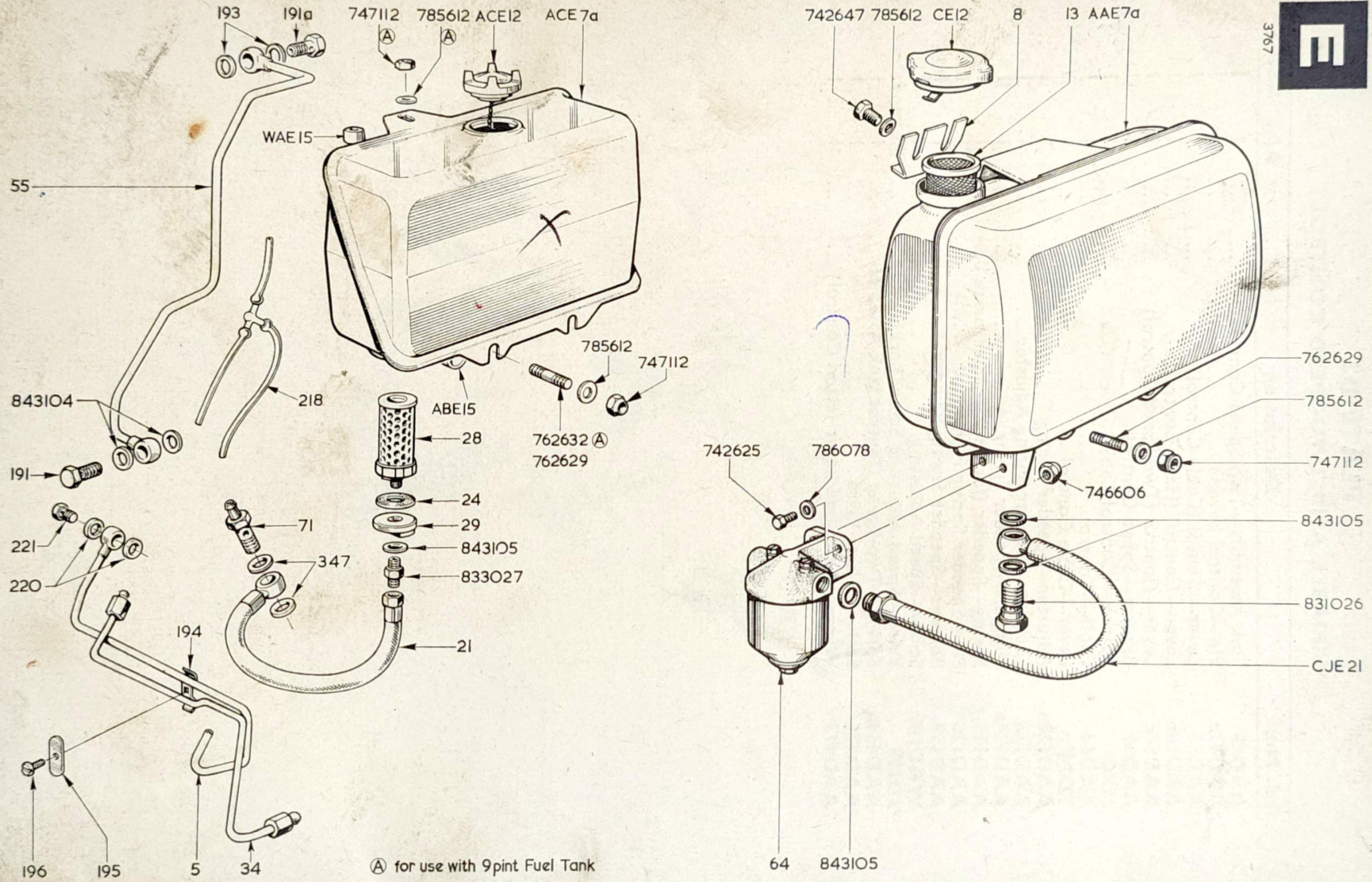
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Ⓐ for use with 9pint Fuel Tank

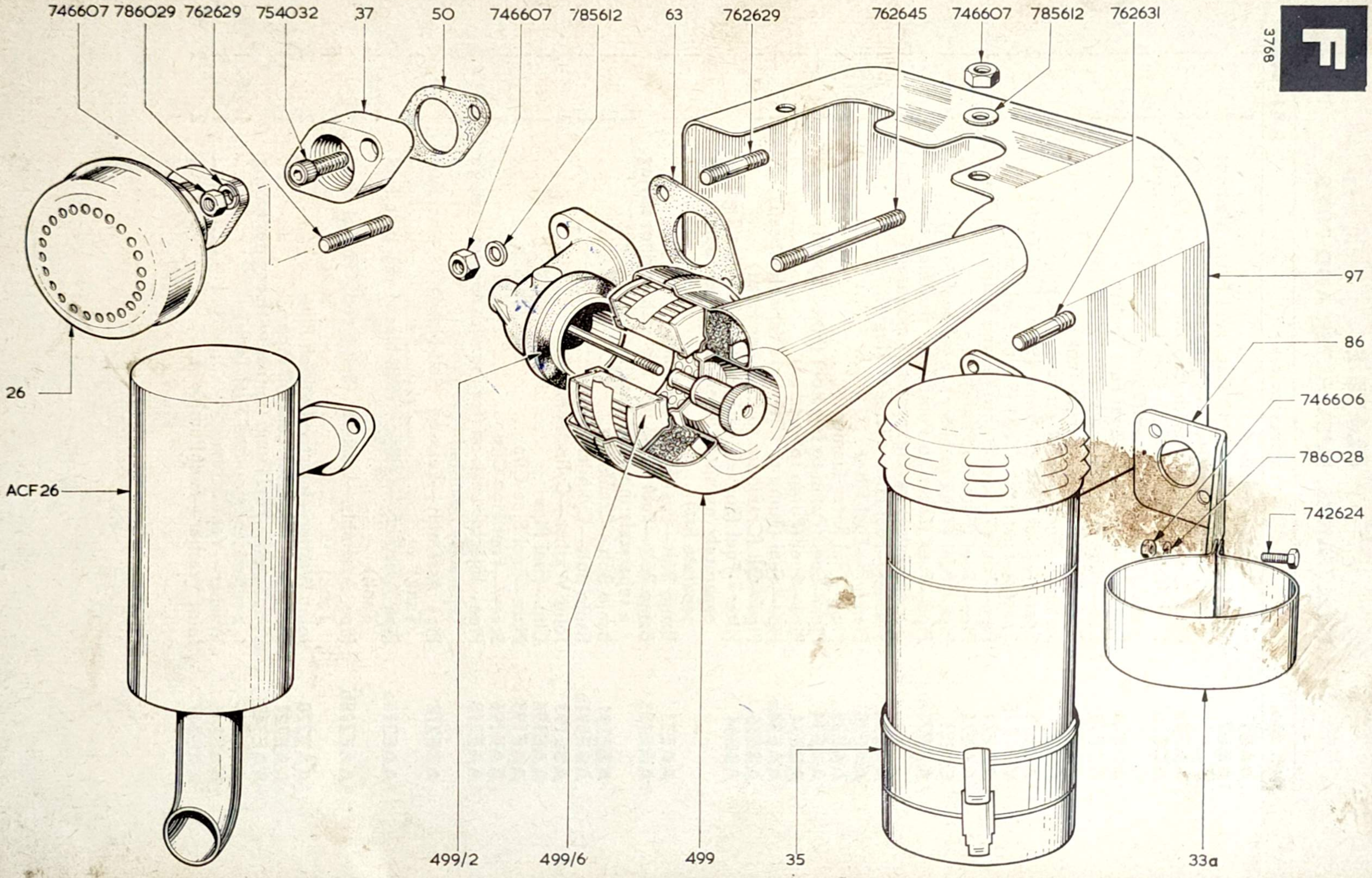
PLATE E

FUEL TANKS, FUEL FILTER AND PIPES

Ref. No.	Description	AA1	AB1
AAE5	Pipe—Injector Leak-off	1	1
*AAE7	Fuel Tank, complete with Cap, Fuel Filter Element and Element Retainer (6½ pint)	1	1
AAE7a	Fuel Tank, complete with Cap and Strainer (2 gal)	1	1
ACE7a	Fuel Tank, complete with Cap, Fuel Filter Element and Element Retainer (9 pint)	1	1
AAE8	Bracket—Fuel Tank (2 gal Fuel Tank)	1	1
ACE12	Cap—Fuel Tank (6½ and 9 pint Fuel Tank)	1	1
CE12	Cap—Fuel Tank (2 gal Fuel Tank)	1	1
JE13	Strainer—Fuel Tank (2 gal Fuel Tank)	1	1
ABE15	Spacer—Fuel Tank (Bottom) (9 pint Fuel Tank)	2	2
WAE15	Spacer—Fuel Tank (Top) (9 pint Fuel Tank)	1	1
AAE21	Pipe—Fuel (Tank to Pump) (6½ and 9 pint Fuel Tank)	1	1
AAE21	Pipe—Fuel (Filter to Pump)	1	1
CJE21	Pipe—Fuel (Tank to Filter) (2 gal Fuel Tank)	1	1
*AAE21a	Pipe—Fuel (Filter to Pump—24″ flexible) (For use with engines having separately mounted Fuel Tank)	1	1
AAE24	Washer—Fuel Filter Element Plug	1	1
AAE28	Element—Fuel Filter	1	1
AAE29	Plug—Fuel Filter Element	1	1
*AAE34	Pipe—Fuel (Pump to Injector) (Fixed Speed)	1	—
ABE34	Pipe—Fuel (Pump to Injector)	—	1
*AAE34a	Pipe—Fuel (Pump to Injector) (Variable Speed)	1	—
ABE55	Pipe—Oil (Crankcase to Cylinder Head)	1	1
ASE64	Filter—Fuel (For use with engines having a 2 gal or separately mounted Fuel Tank) (for details see separate list)	1	1
AAE71	Banjo Bolt—Fuel Pump (self-bleed)	1	1
*AAE123	Banjo Bolt—Fuel Pump (for use with engines having a separately mounted Fuel Tank)	1	1
ABE191	Banjo Bolt—Crankcase	1	1
ABE191a	Banjo Bolt—Cylinder Head	1	1
ABE193	Joint Washer—Cylinder Head	2	2
AAE194	Clip—Fuel Pipe	1	1
AAE195	Plate—Fuel Pipe Clip	1	1
AAE196	Screw—Fuel Pipe Clip	1	1
*AAE218	Pipe—Injector Leak-off (for use with engines having a separately mounted Fuel Tank)	1	1
ABE218	Pipe Assembly—Leak-off (Self-bleed) (9 pint Fuel Tank)	1	1
*AAE218a	Pipe Assembly—Leak-off (Self-bleed) (6½ pint Fuel Tank)	1	1
*AAE218b	Pipe Assembly—Leak-off (Self-bleed) (2 gal Fuel Tank)	1	1
AAE220	Joint Washer—Injector Leak-off Pipe	2	2
AAE221	Banjo Bolt—Injector Leak-off Pipe	1	1
*AAE345	Vent Screw—Fuel Pump (for use with engines having a separately mounted Fuel Tank)	1	1
*AAE346	Washer—Vent Screw	1	1
AAE347	Joint Washer—Fuel Pump	2	2

F

3768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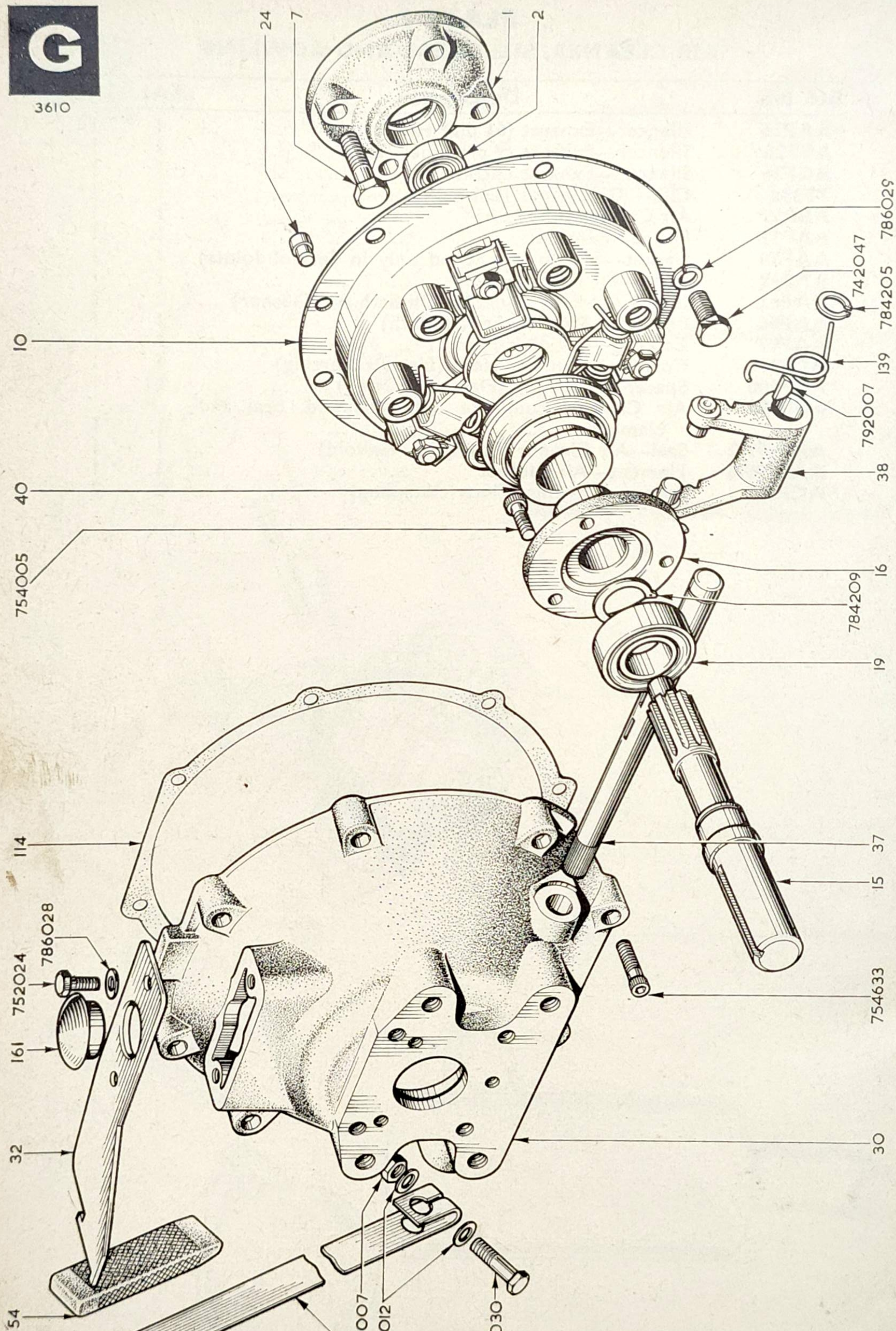
762629
754032
37
50
746607
785612
63
762629
762645
746607
785612
762631
97
86
746606
786028
742624
26
ACF26
499/2
499/6
499
35
33a

PLATE F

AIR CLEANER, SILENCERS AND COWLING

Ref. No.	Description	AA1	AB1
*AAF26	Silencer—Exhaust (6½ pint Fuel Tank)	1	1
ABF26	Silencer—Exhaust (9 pint Fuel Tank)	1	1
ACF26	Silencer—Exhaust (Acoustic)	1	1
TF33a	Clip—Air Cleaner (Oil Bath)	1	1
ABF35	Air Cleaner (Oil Bath)	1	1
AAF37	Flange—Exhaust	1	1
AAF50	Gasket—Exhaust (Supplied only in Sets of Joints)	1	1
AAF63	Joint—Air Inlet Manifold	1	1
AAF63	Joint—Air Inlet Manifold (Oil Bath Air Cleaner) ...	2	2
AAF86	Bracket—Air Cleaner (Oil Bath)	1	1
AAF97	Cowling—Cylinder Head	1	1
*ACF97	Cowling—Cylinder Head (Electric Starting) ...	1	1
*ACF100	Spacer—Fuel Tank (Electric Starting)	1	1
ABF499	Air Cleaner, complete with Manifold, Seal and Element	1	1
AAF499/2	Seal—Air Cleaner (Casing to Manifold)	1	1
AAF499/6	Element—Air Cleaner	1	1
*ACF557	Spacer—Cowling (Electric Starting)	2	2

3610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742047
784205
792007
754005
784209
752024
786028
754633
746007
785012
745030

PLATE G

CLUTCH

Ref. No.	Description	AA1	AB1
ACG1	Housing—Bearing	1	1
ACG2	Bearing—Ball	1	1
AAG7	Bolt—Bearing Housing	4	4
AAG10	Clutch Plate Assembly	1	1
AAG15	Shaft—Power Take-off	1	1
AAG16	Sleeve—Thrust Bearing Retaining	1	1
AAG19	Bearing—Ball	1	1
AAG24	Dowel—Clutch Locating	2	2
AAG30	Housing—Clutch	1	1
AAG32	Guide—Lever Operating	1	1
AAG36	Lever—Clutch Operating	1	1
AAG37	Shaft—Yoke	1	1
AAG38	Yoke	1	1
AAG40	Bearing—Thrust	1	1
AAG54	Grip—Lever	1	1
AAG114	Shim—Clutch Housing	As reqd.	
AAG139	Spring—Yoke Return	1	1
AAG161	Plug—Operating Lever Guide	1	1

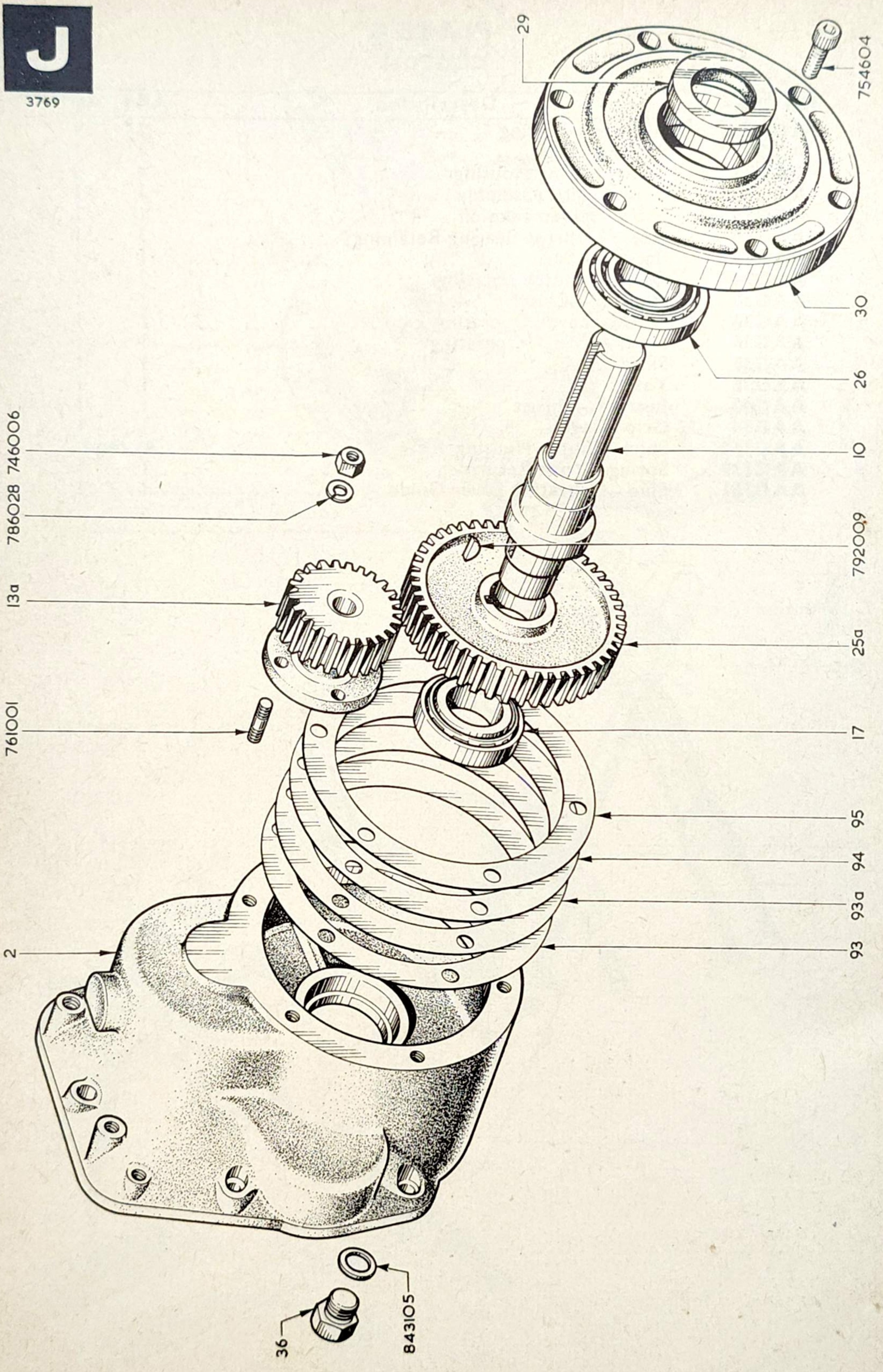

761001
786028
746006
754604
792009
843105

PLATE J

REDUCTION GEAR

Ref. No.	Description	AA1	AB1
AAJ2	Housing—Reduction Gear	1	1
AAJ10	Shaft—Power Take-off	1	1
*AAJ13	Gearwheel—Driving (4:1 Ratio)	1	1
*AAJ13a	Gearwheel—Driving (6:1 Ratio)	1	1
AAJ17	Bearing—Roller (Inner)	1	1
*AAJ25	Gearwheel—Driven (4:1 Ratio)	1	1
*AAJ25a	Gearwheel—Driven (6:1 Ratio)	1	1
AAJ26	Bearing—Roller (Outer)	1	1
AAJ29	Oil Seal	1	1
AAJ30	Housing—Bearing	1	1
AAJ36	Plug—Drain	1	1
AAJ93	Shim—Bearing Housing (0·002″)	As reqd.	
AAJ93a	Shim—Bearing Housing (0·005″)	As reqd.	
AAJ94	Shim—Bearing Housing (0·007″)	As reqd.	
AAJ95	Shim—Bearing Housing (0·020″)	As reqd.	

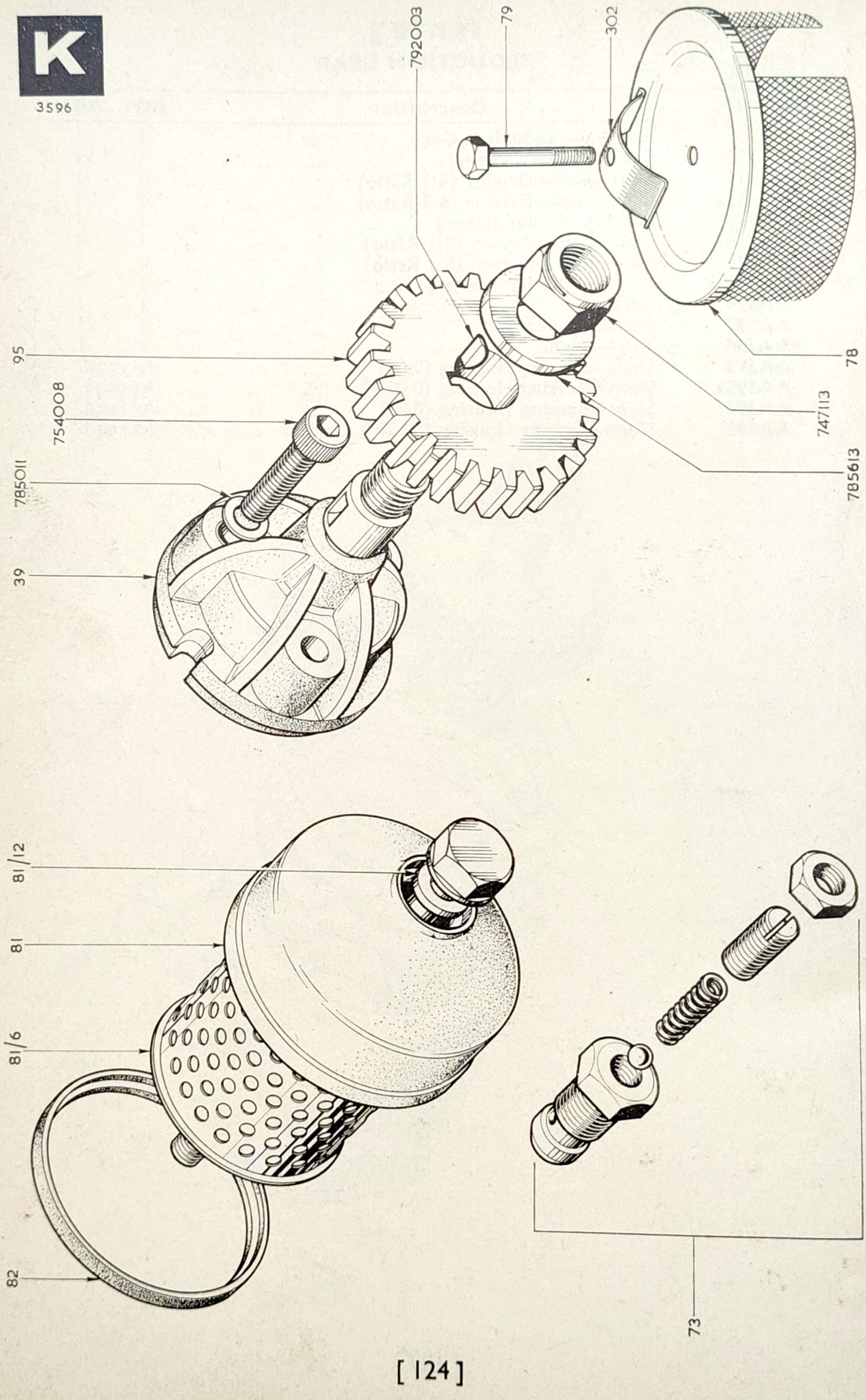

3596
792003
79
302
95
754008
785011
39
78
747113
785613
81/12
81
81/6
82
73

PLATE K

OIL PUMP, OIL FILTER AND STRAINER

Ref. No.	Description	AA1	AB1
AAK39	Pump—Lubricating Oil	1	1
ABK73	Relief Valve Assembly	1	1
AAK78	Strainer—Oil Pump	1	1
AAK79	Bolt—Oil Pump Strainer	1	1
AAK81	Filter—Lubricating Oil, complete with Joint and Element	1	1
AAK81/6	Element—Filter	1	1
AAK81/12	Joint Washer—Filter (Supplied only in Sets of Joints)	1	1
AAK82	Joint—Filter	1	1
AAK95	Gearwheel—Oil Pump	1	1
AAK302	Clip—Oil Pump Strainer	1	1

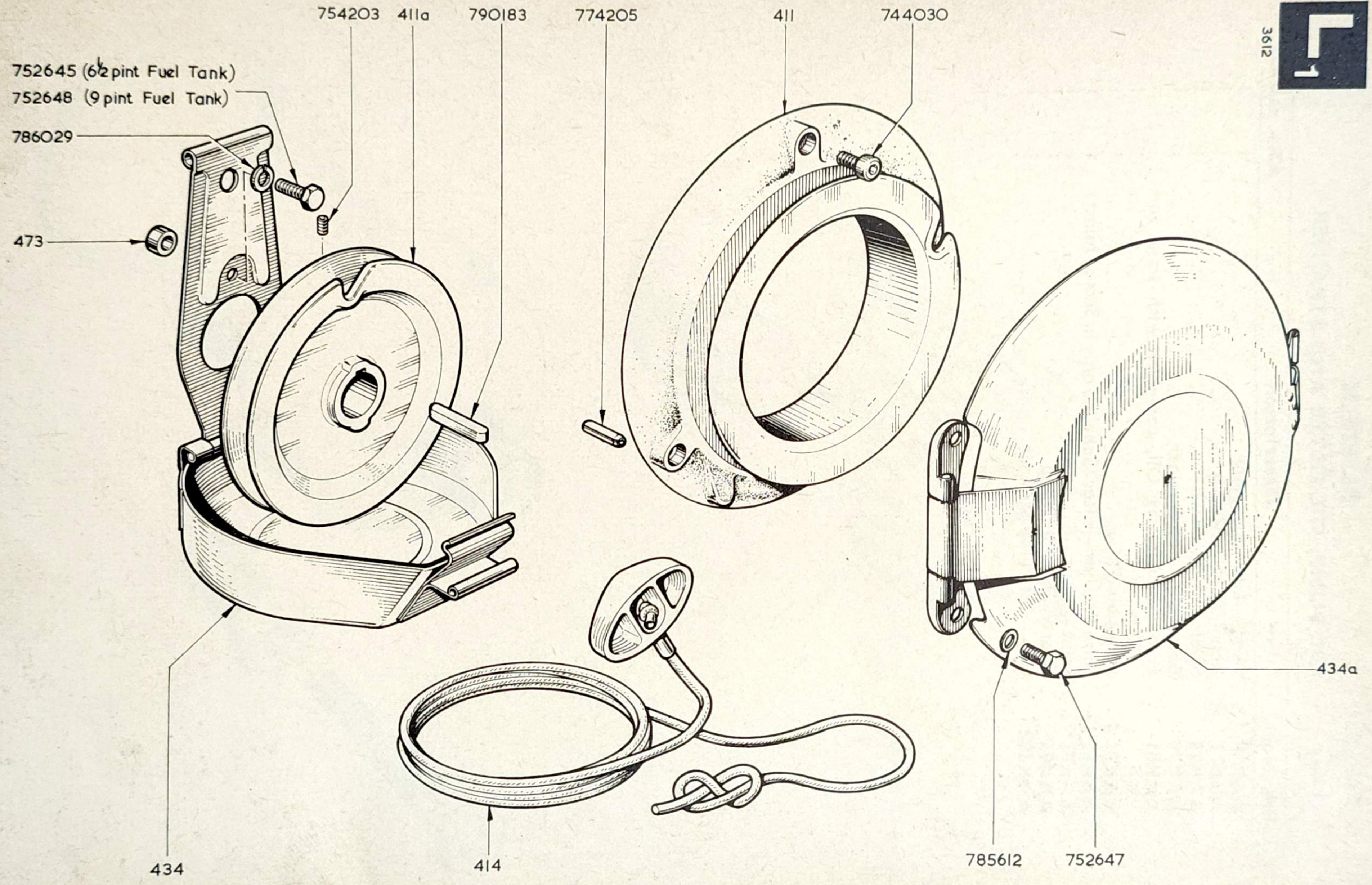
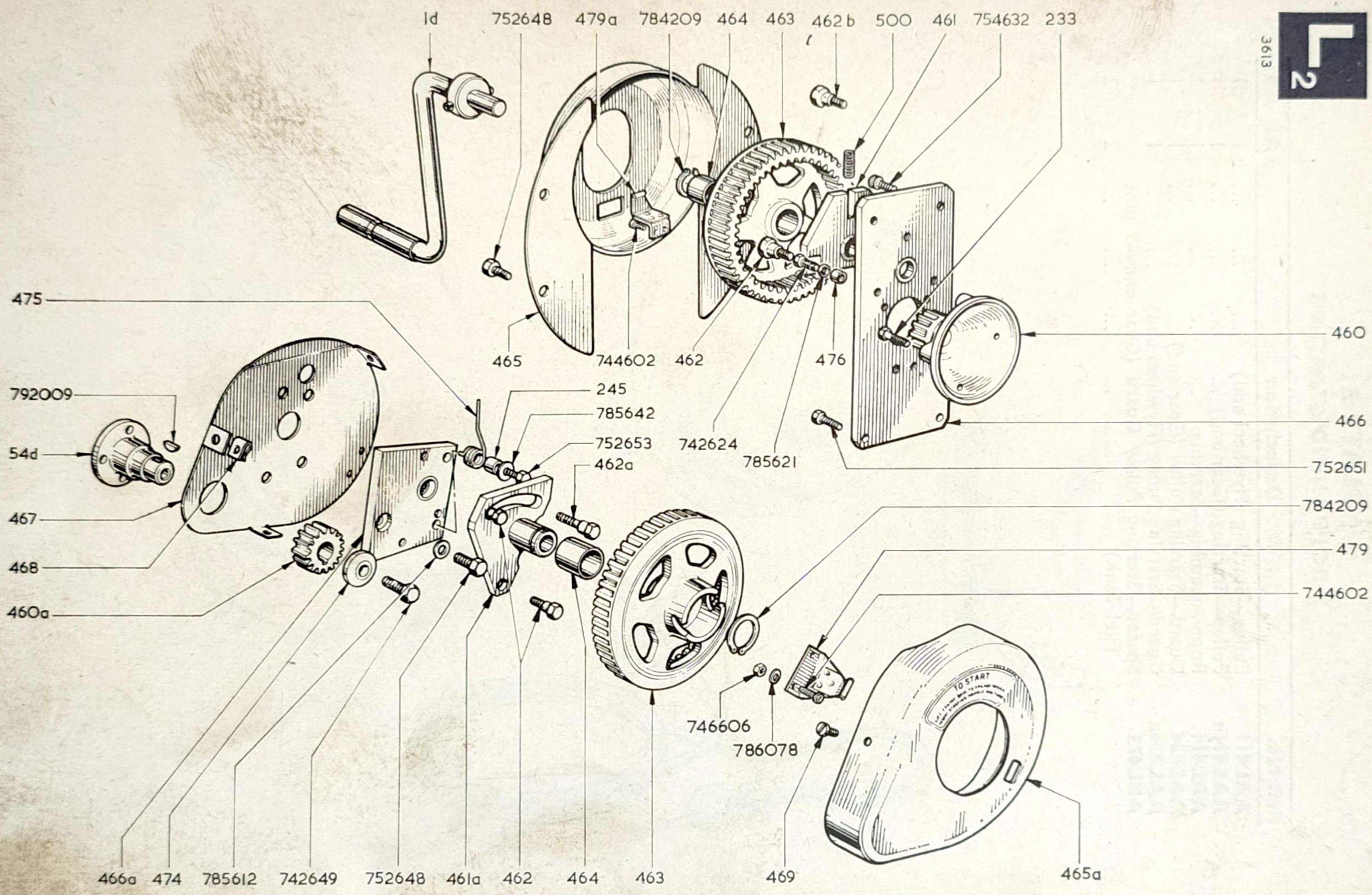

752645 (6½ pint Fuel Tank)
752648 (9 pint Fuel Tank)
786029
473
754203
411a
790183
774205
411
744030
434
414
785612
752647
434a

PLATE LI

ROPE HAND STARTING

Ref. No.	Description	AA1	AB1
AAL411	Pulley—Starting (Flywheel end)	1	1
AAL411a	Pulley—Starting (Gear end)	1	1
AAL414	Rope Assembly—Starting	1	1
AAL434	Guard—Starting Pulley (Gear end)	1	1
AAL434a	Guard—Starting Pulley (Flywheel end)	1	1
ABL473	Spacer—Starting Pulley Guard (Gear end—9 pint Fuel Tank)	2	2


1d
752648
479a
784209
464
463
462 b
500
461
754632
233
475
465
744602
462
476
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245
785642
752653
462a
742624
785621
466
752651
792009
54d
467
468
460a
784209
479
744602
746606
786078
466a
474
785612
742649
752648
461a
462
464
463
469
465a
TO START

PLATE L2

4:1 HAND STARTING

Ref. No.	Description	AA1	AB1
AAL1d	Starting Handle	1	1
*ABL1	Starting Handle (Long)	1	1
AAL54d	Shaft—Crankshaft Extension (Gear end)	1	1
AAL233	Bolt—Flywheel Extension Gearwheel	4	4
AAL245	Spacer—Return Spring (Gear end)	1	1
AAL460	Gearwheel—Flywheel Extension	1	1
AAL460a	Gearwheel—Crankshaft Extension (Gear end) ...	1	1
AAL461	Plate—Sliding (Flywheel end)	1	1
AAL461a	Plate—Sliding (Gear end)	1	1
AAL462	Screw—Sliding Plate Location (Gear end)	2	2
AAL462	Screw—Sliding Plate Location (Flywheel end) ...	2	2
AAL462a	Screw—Sliding Plate Location (Gear end)	1	1
AAL462b	Screw—Sliding Plate Location (Flywheel end) ...	1	1
AAL403 AAL463	Gearwheel—Starting	1	1
AAL464	Bearing—Starting Gearwheel	1	1
AAL465	Guard—Starting Gears (Flywheel end)	1	1
AAL465a	Guard—Starting Gears (Outer—Gear end) ...	1	1
AAL466	Plate—Mounting (Flywheel end)	1	1
AAL466a	Plate—Mounting (Gear end)	1	1
AAL467	Guard—Starting Gears (Inner—Gear end)	1	1
AAL468	Fastener—Guard (Gear end)	3	3
AAL469	Screw—Guard Fastener (Gear end)	3	3
AAL474	Plate—Gearwheel Retaining (Gear end)	1	1
AAL475	Spring—Return (Gear end)	1	1
AAL476	Stop—Sliding Plate (Flywheel end)	2	2
AAL479	Clip—Gearwheel Retaining (Gear end)	1	1
AAL479a	Clip—Gearwheel Retaining (Flywheel end) ...	1	1
AAL500	Spring—Sliding Plate (Flywheel end)	1	1

L3

3770

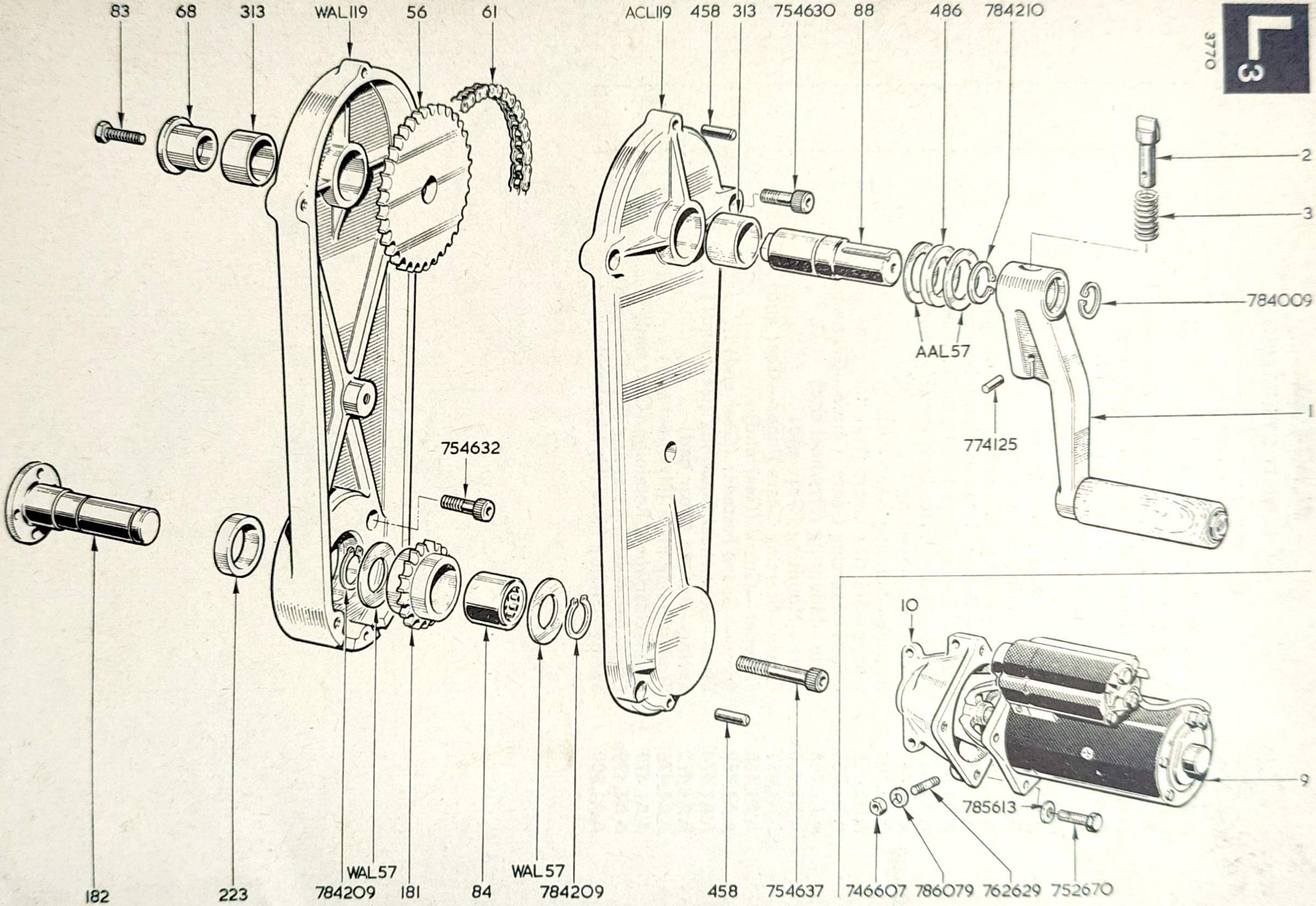

83
68
313
WAL119
56
61
ACL119
458
313
754630
88
486
784210
2
3
784009
AAL57
774125
1
754632
10
9
785613
182
223
784209
WAL57
181
84
WAL57
784209
458
754637
746607
786079
762629
752670

PLATE L3

RAISED HAND AND ELECTRIC STARTING

Ref. No.	Description	AA1	AB1
WAL1	Starting Handle Assembly	1	1
	Consisting of:		
	AAL2 Plunger—Starting Handle	1	1
	AAL3 Spring—Starting Handle Plunger ...	1	1
	774125 Pin—Starting Handle Plunger ...	1	1
	784009 Circlip—Starting Handle	1	1
ACL9	Starter Motor	1	1
ACL10	Bracket—Starter Motor	1	1
***BAL44**	Switch—Starter	1	1
WAL56	Chainwheel—Upper	1	1
AAL57	Washer—Starting Shaft	2	2
WAL57	Washer—Clutch	2	2
WAL61	Chain—Starting	1	1
AAL68	Shaft—Chainwheel Retaining	1	1
AAL83	Screw—Chainwheel Retaining Shaft	1	1
WAL84	Clutch—Roller	1	1
WAL88	Shaft—Starting Handle	1	1
ACL119	Housing—Chain (Outer)	1	1
WAL119	Housing—Chain (Inner)	1	1
WAL181	Chainwheel—Lower	1	1
ACL182	Shaft—Camshaft Extension	1	1
AAL223	Sleeve—Spigot	1	1
AAL313	Bush—Chain Housing	2	2
AAL458	Dowel—Chain Housing	2	2
WAL486	Washer—Starting Handle Shaft	1	1

N

3600

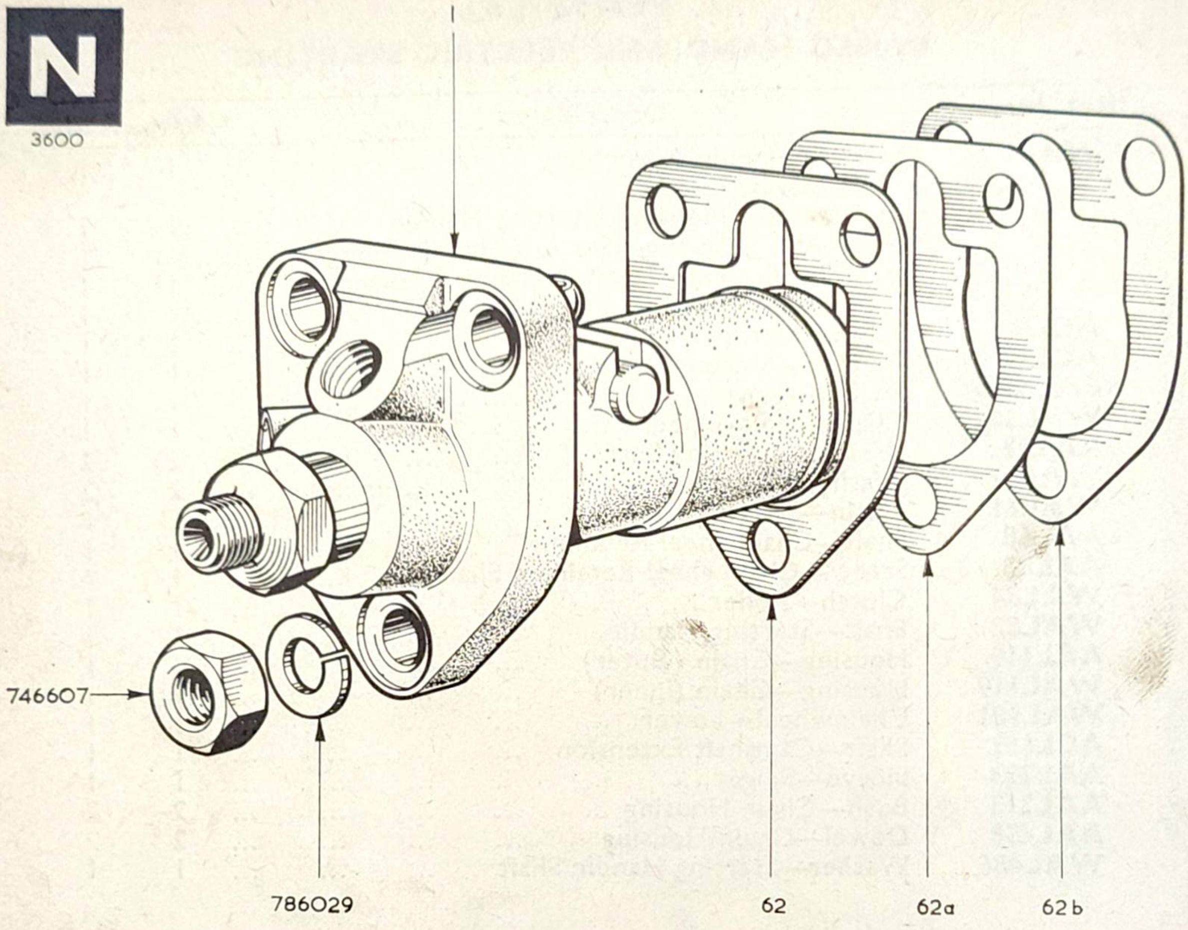
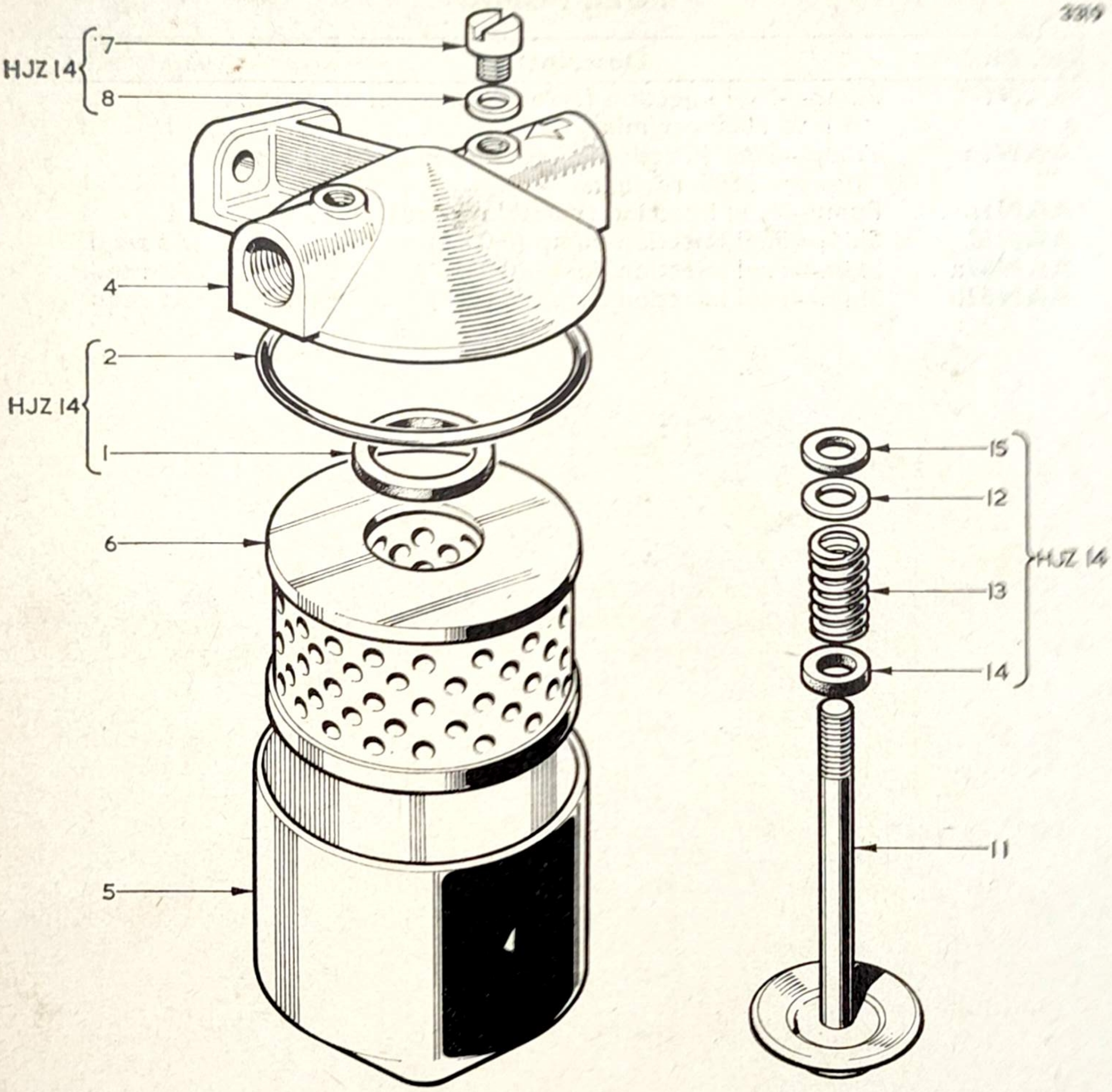

746607
786029
62
62a
62b

PLATE N

FUEL PUMPS

Ref. No.	Description	AA1	AB1
AAN1	Pump—Fuel Injection (Fixed Speed and two-speed up to 3000 rev/min)	1	1
***AAN1a**	Pump—Fuel Injection (Fixed Speed and two speed up to 3600 rev/min)	1	1
***AAN1b**	Pump—Fuel Injection (Variable Speed)	1	1
AAN62	Shim—Fuel Injection Pump (0·005″)	As reqd.	
AAN62a	Shim—Fuel Injection Pump (0·0025″)	As reqd.	
AAN62b	Shim—Fuel Injection Pump (0·025″)	As reqd.	


339
HJZ 14
7
8
4
HJZ 14
2
1
6
5
15
12
13
14
HJZ 14
11

FUEL FILTER ASE64

Ref. No.		Description
ASE64/4		Head
ASE64/5		Bowl
ASE64/6		Element
ASE64/11		Bolt—Centre
HJZ14	Spare Parts Pack, consisting of:	
	ASE61/1	Joint Washer—Element
	ASE64/2	Seal—Bowl
	ASE64/7	Screw—Vent
	ASE64/8	Washer—Vent Screw
	ASE64/12	Washer—Centre Bolt
	ASE64/13	Spring—Centre Bolt
	ASE64/14	Seal—Centre Bolt (Lower)
	ASE64/15	Seal—Centre Bolt (Upper)

SPEEDER SPRING DETAILS

Ref. No.	Colour	Position	Speed	AA1	AB1
AAD125g	Aluminium/Yellow	Bands	1500	1	1
AAD125f	Aluminium/Orange	Bands	1800	1	1
AAD125e	Orange/Blue	Ends	2100	1	1
AAD125d	Aluminium/Brown	Ends	2500	1	1
			3000	—	1
†**AAD125**	Orange/Blue	Bands	3000	1	—
			3600	—	1
†**AAD125c**	Brown/Yellow	Bands	3600	1	—
†**AAD125a**	Aluminium/Blue	Bands	Variable and Two-Speed	1	1

†For 3000 rev/min fixed and two-speed engines Fuel Pump AAN1 must be fitted. For 3600 rev/min fixed or two-speed engines Fuel Pump AAN1a must be fitted, and for variable speed engines Fuel Pump AAN1b must be fitted. (See Parts List Plate N.)

AIR CLEANER, FUEL AND OIL FILTER ELEMENT PACKS

Ref. No.	Description	AA1	AB1
AAZ9	Complete Set of Element Packs	1	1
	Consisting of:		
	AAZ10 Element Pack—Fuel Filter	1	1
	AAZ11 Element Pack—Oil Filter	1	1
	AAZ12 Element Pack—Air Cleaner ..	1	1
AAZ10	Element Pack—Fuel Filter	1	1
	Consisting of:		
	AAE24 Joint Washer—Element Plug ...	4	4
	AAE28 Element—Fuel Filter	4	4
AAZ11	Element Pack—Oil Filter	1	1
	Consisting of:		
	AAK81/6 Element—Oil Filter	8	8
	AAK81/12 Joint Washer	8	8
AAZ12	Element Pack—Air Cleaner	1	1
	Consisting of:		
	AAF499/6 Element—Air Cleaner	4	4

SETS OF JOINTS

Ref. No.	Description	AA1	AB1
AAZ1	Complete Set of Joints	1	—
	Consisting of:		
	AAZ2 Decarbonizing Set of Joints ...	1	—
	AAZ3 Conversion Set of Joints	1	—
ABZ1	Complete Set of Joints	—	1
	Consisting of:		
	ABZ2 Decarbonising Set of Joints ...	—	1
	AAZ3 Conversion Set of Joints	—	1
AAZ2	Decarbonising Set of Joints	1	—
	Consisting of: (see Plates B and F)		
	AAB4 Joint—Rocker Box Cover	1	—
	AAB58 Gasket—Cylinder Head	1	—
	AAB61 Joint Washer—Fuel Injector Nozzle	1	—
	AAB89 Joint—Push Rod Tube Base ...	1	—
	ABB94 Seal—Push Rod Tube	4	—
	AAF50 Gasket—Exhaust	1	—
	AAF63 Joint—Air Inlet Manifold	1	—
ABZ2	Decarbonising Set of Joints	—	1
	Consisting of: (see Plates B and F)		
	AAB4 Joint—Rocker Box Cover	—	1
	ABB58 Gasket—Cylinder Head	—	1
	AAB61 Joint Washer—Fuel Injector Nozzle	—	1
	AAB89 Joint—Push Rod Tube Base ...	—	1
	ABB94 Seal—Push Rod Tube	—	4
	AAF50 Gasket—Exhaust	—	1
	AAF63 Joint—Air Inlet Manifold	—	1
AAZ3	Conversion Set of Joints	1	1
	Consisting of: (see Plates A, C, D and E)		
	AAA56 Joint—Gear Cover	1	
	AAA139 Joint—Sump	1	1
	AAC7 Joint—Main Bearing Housing ...	1	1
	AAC7 Joint—Main Bearing Housing ...	1	1
	AAD256 Joint—Cover (Stop/Run Lever Assembly)	1	1
	AAE347 Joint Washer—Fuel Pump	2	2
	843105 Joint Washer, ½″ (Copper) (Drain Plug)	2	2

COMMON DETAIL PARTS—AA1 and AB1

‡Denotes that part must be obtained from Petters Ltd or their agents
Stud lengths quoted are overall lengths

Ref. No.	Description
710603	Screw—Cheese Head, 2BA × $\frac{1}{4}$″ (Plated)
71060	Screw—Cheese Head, 2BA × $\frac{3}{8}$″ (Plated)
710609	Screw—Cheese Head, 3BA × $\frac{3}{4}$″ (Plated)
716601	Nut, 2BA (Plated)
716614	Locknut, 2BA (Plated)
720002	Screw—Cheese Head, $\frac{1}{4}$″ BSF × $\frac{1}{2}$″
721003	Screw—Countersunk, $\frac{1}{4}$″ BSF × $\frac{5}{8}$″
742047	Screw—Hex Head, $\frac{5}{16}$″ UNF × $\frac{3}{4}$″
742624	Screw—Hex Head, $\frac{1}{4}$″ UNF × $\frac{5}{8}$″ (Plated)
742625	Screw—Hex Head, $\frac{1}{4}$″ UNF × $\frac{3}{4}$″ (Plated)
742647	Screw—Hex Head, $\frac{5}{16}$″ UNF × $\frac{3}{4}$″ (Plated)
742649	Screw—Hex Head, $\frac{5}{16}$″ UNF × 1″ (Plated)
742777	Screw—Hex Head, $\frac{5}{16}$″ UNF × $\frac{3}{8}$″ (Plated)
744002	Capscrew—Socket Head, $\frac{1}{4}$″ UNF × $\frac{1}{2}$″
744003	Capscrew—Socket Head, $\frac{1}{4}$″ UNF × $\frac{5}{8}$″
744030	Capscrew—Socket Head, $\frac{5}{16}$″ UNF × $\frac{3}{4}$″
744201	Grubscrew—Socket Head, $\frac{1}{4}$″ UNF × $\frac{1}{4}$″ (Cup Point)
744238	Grubscrew—Socket Head, $\frac{7}{16}$″ UNF × $\frac{1}{2}$″ (Cup Point)
744602	Capscrew—Socket Head, $\frac{1}{4}$″ UNF × $\frac{1}{2}$″ (Plated)
745010	Bolt—Hex Head, $\frac{1}{4}$″ UNF × 1$\frac{3}{4}$″
745030	Bolt—Hex Head, $\frac{5}{16}$ UNF × 1$\frac{3}{8}$″
745031	Bolt—Hex Head, $\frac{5}{16}$″ UNF × 1$\frac{1}{2}$″
746006	Nut, $\frac{1}{4}$″ UNF
746007	Nut, $\frac{1}{4}$″ UNF
746016	Locknut, $\frac{1}{4}$″ UNF
746605	Nut, 10–32 UNF (Plated)
746606	Nut, $\frac{1}{4}$″ UNF (Plated)
746607	Nut, $\frac{5}{16}$″ UNF (Plated)
746618	Locknut, $\frac{3}{8}$″ UNF (Plated)
‡746626	Nut (Plated)
747017	Nut, $\frac{5}{16}$″ UNF (Self-Locking) (Nylon Insert) (Thin)
747112	Nut, $\frac{5}{16}$″ UNF (Self-Locking) (Phosphated) (Thin)
747113	Nut, $\frac{3}{8}$″ UNF (Self-Locking) (Phosphated) (Thin)
747115	Nut, $\frac{1}{2}$″ UNF (Self-Locking) (Phosphated) (Thin)
748003	Wingnut, $\frac{1}{4}$″ UNF (Plated)
752024	Screw—Hex Head, $\frac{1}{4}$″ UNC × $\frac{5}{8}$″
752623	Screw—Hex Head, $\frac{1}{4}$″ UNC × $\frac{1}{2}$″ (Plated)
752645	Screw—Hex Head, $\frac{5}{16}$″ UNC × $\frac{1}{2}$″ (Plated)
752646	Screw—Hex Head, $\frac{5}{16}$″ UNC × $\frac{5}{8}$″ (Plated)
752647	Screw—Hex Head, $\frac{5}{16}$″ UNC × $\frac{3}{4}$″ (Plated)
752648	Screw—Hex Head, $\frac{5}{16}$″ UNC × $\frac{7}{8}$″ (Plated)
752649	Screw—Hex Head, $\frac{5}{16}$″ UNC × 1″ (Plated)
752651	Screw—Hex Head, $\frac{5}{16}$″ UNC × 1$\frac{1}{4}$″ (Plated)
752653	Screw—Hex Head, $\frac{5}{16}$″ UNC × 1$\frac{1}{2}$″ (Plated)
752670	Screw—Hex Head, $\frac{3}{8}$″ UNC × $\frac{7}{8}$″ (Plated)
754003	Capscrew—Socket Head, $\frac{1}{4}$″ UNC × $\frac{5}{8}$″
752004	Capscrew—Socket Head, $\frac{1}{4}$″ UNC × $\frac{3}{4}$″
754005	Capscrew—Socket Head, $\frac{1}{4}$″ UNC × $\frac{7}{8}$″
754008	Capscrew—Socket Head, $\frac{1}{4}$″ UNC × 1$\frac{1}{2}$″
754031	Capscrew—Socket Head, $\frac{5}{16}$″ UNC × $\frac{7}{8}$″
754032	Capscrew—Socket Head, $\frac{5}{16}$″ UNC × 1″
754203	Grubscrew—Socket Head, $\frac{1}{4}$″ UNC × $\frac{3}{8}$″ (Cup Point)
754604	Capscrew—Socket Head, $\frac{1}{4}$″ UNC × $\frac{3}{4}$″ (Plated)
754630	Capscrew—Socket Head, $\frac{5}{16}$″ UNC × $\frac{3}{4}$″ (Plated)
754632	Capscrew—Socket Head, $\frac{5}{16}$″ UNC × 1″ (Plated)
754633	Capscrew—Socket Head, $\frac{5}{16}$″ UNC × 1$\frac{1}{4}$″ (Plated)
754637	Capscrew—Socket Head, $\frac{5}{16}$″ UNC × 2$\frac{1}{4}$″ (Plated)
754784	Capscrew—Socket Head, $\frac{1}{4}$″ UNC × 1$\frac{1}{8}$″ (Plated)

Ref. No.	Description
755630	Bolt—Hex Head, $\frac{5}{16}$" UNC × $1\frac{3}{8}$" (Plated)
755632	Bolt—Hex Head, $\frac{5}{16}$" UNC × $1\frac{3}{4}$" (Plated)
756007	Nut, $\frac{5}{16}$" UNC
761001	Stud, $\frac{1}{4}$" UNF × 1"
762037	Stud, $\frac{5}{16}$" UNF/UNC × $2\frac{1}{8}$"
762629	Stud, $\frac{5}{16}$" UNF/UNC × $1\frac{1}{8}$" (Plated)
762630	Stud, $\frac{5}{16}$" UNF/UNC × $1\frac{1}{4}$" (Plated)
762631	Stud, $\frac{5}{16}$" UNF/UNC × $1\frac{3}{8}$" (Plated)
762632	Stud, $\frac{5}{16}$" UNF/UNC × $1\frac{1}{2}$" (Plated)
762645	Stud, $\frac{5}{16}$" UNF/UNC × $3\frac{1}{8}$" (Plated)
763404	Screw—Pan Head, No. 4 × $\frac{3}{8}$" (Self-tapping) (Plated)
763832	Screw—Hammer Drive, No. 10 × $\frac{3}{8}$" (Plated)
773148	Split Pin, $\frac{3}{64}$" × $\frac{3}{8}$"
773149	Split Pin, $\frac{1}{16}$" × $\frac{7}{16}$"
774118	Pin—Spring Tension, $\frac{1}{8}$" × $\frac{1}{4}$" (Plated)
774122	Pin—Spring Tension, $\frac{1}{8}$" × $\frac{1}{2}$" (Plated)
774125	Pin—Spring Tension, $\frac{1}{8}$" × $\frac{3}{4}$" (Plated)
774160	Pin—Spring Tension, $\frac{3}{16}$" × $\frac{7}{8}$" (Plated)
774204	Pin—Spring Tension, $\frac{1}{8}$" × $\frac{11}{16}$" (Plated)
774205	Pin—Spring Tension, $\frac{3}{16}$" × $\frac{11}{16}$" (Plated)
784008	Circlip, $\frac{7}{8}$" (Internal)
784009	Circlip, 1" (Internal)
784201	Circlip, $\frac{3}{16}$" (External)
784203	Circlip, $\frac{3}{8}$" (External)
784205	Circlip, $\frac{9}{16}$" (External)
784209	Circlip, 1" (External)
784210	Circlip, $1\frac{1}{8}$" (External)
785011	Washer—Bright, $\frac{1}{4}$" (Small) (Heavy Gauge)
785012	Washer—Bright, $\frac{5}{16}$" (Small) (Heavy Gauge)
785605	Washer, 2BA (Small) (Heavy Gauge) (Plated)
785611	Washer, $\frac{1}{4}$" (Small) (Heavy Gauge) (Plated)
785612	Washer, $\frac{5}{16}$" (Small) (Heavy Gauge) (Plated)
785613	Washer, $\frac{3}{8}$" (Small) (Heavy Gauge) (Plated)
785621	Washer, $\frac{1}{4}$" (Small) (Light Gauge) (Plated)
785631	Washer, $\frac{1}{4}$" (Large) (Heavy Gauge) (Plated)
785642	Washer, $\frac{1}{4}$" (Large) (Light Gauge) (Plated)
786027	Spring Washer—Single Coil, $\frac{3}{16}$" (Rectangular Section)
786028	Spring Washer—Single Coil, $\frac{1}{4}$" (Rectangular Section)
786029	Spring Washer—Single Coil, $\frac{5}{16}$" (Rectangular Section)
786078	Spring Washer—Single Coil, $\frac{1}{4}$" (Rectangular Section) (Plated)
786079	Spring Washer—Single Coil, $\frac{5}{16}$" (Rectangular Section) (Plated)
786506	Washer—Shakeproof, $\frac{1}{4}$" (Internal Teeth)
786710	Washer—Shakeproof, $\frac{5}{8}$" (Internal Teeth) (Sealing)
790182	Key—Parallel, $\frac{1}{4}$" × $\frac{1}{4}$" × $1\frac{1}{4}$" (Round End)
790183	Key—Parallel, $\frac{1}{4}$" × $\frac{1}{4}$" × $1\frac{3}{8}$" (Round End)
790185	Key—Parallel, $\frac{1}{4}$" × $\frac{1}{4}$" × $1\frac{3}{4}$" (Round End)
792002	Key——Woodruff, $\frac{3}{32}$" × $\frac{3}{8}$"
792003	Key—Woodruff, $\frac{1}{8}$" × $\frac{3}{8}$"
792003	Key—Woodruff, $\frac{1}{8}$" × $\frac{3}{8}$"
792007	Key—Woodruff, $\frac{3}{32}$" × $\frac{5}{8}$"
792008	Key—Woodruff, $\frac{1}{8}$" × $\frac{5}{8}$"
792009	Key—Woodruff, $\frac{5}{32}$" × $\frac{5}{8}$"
792011	Key—Woodruff, $\frac{5}{32}$" × $\frac{3}{4}$"
792018	Key—Woodruff, $\frac{5}{16}$" × 1"
831026	Bolt—Banjo, $\frac{1}{4}$" BSP
‡833027	Union (Pipe fitting one end only)
843005	Joint Washer, $\frac{1}{2}$" (Fibre)
843104	Joint Washer, $\frac{3}{8}$" (Copper)
843105	Joint Washer, $\frac{1}{2}$" (Copper)
‡844105	Oil Seal, No. 10
‡844106	Oil Seal, No. 11

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